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TECHNICAL REPORT RK-CR-84-3

A COMPUTER PROGRAM FOR THE PERFORMANCE ANALYSIS OF SCARFED NOZZLES

Prepared by:

Joe D. Hoffman
Battelle Columbus Research Laboratories
Research Triangle Park, NC 27709

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Propulsion Directorate
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An analysis is presented for predicting the performance of scarfed propulsive nozzles. The model assumes that the scarfing is not severe, so that the flow within the nozzle is axisymmetric. The flowfield within the nozzle and the scarfed nozzle extension is calculated by the method of characteristics. The oblique shock wave emaninating from the junction of the nozzle and the scarfed nozzle extension is fitted discretely and tracked through the flowfield. The nozzle forces are determined by integrating the wall pressure distribution.

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Nozzle axial and side forces are calculated, and missile axial and side forces are determined. A computer program implementing the analysis is discussed. Fifteen sample cases are presented to illustrate the use of the computer program.

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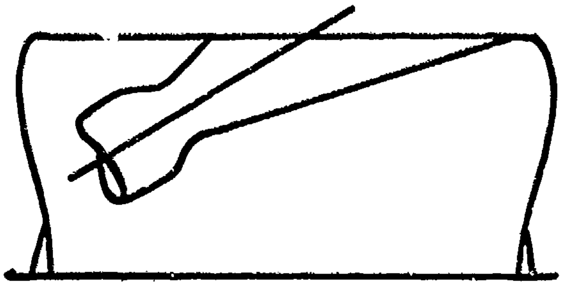
INTRODUCTION

The conventional propulsive nozzle is an axisymmetric converging-diverging nozzle terminating in a plane perpendicular to the axis of the nozzle. If the flow entering the nozzle is axisymmetric, then the flow within the nozzle is also axisymmetric, and the resultant thrust vector lies along the nozzle axis.

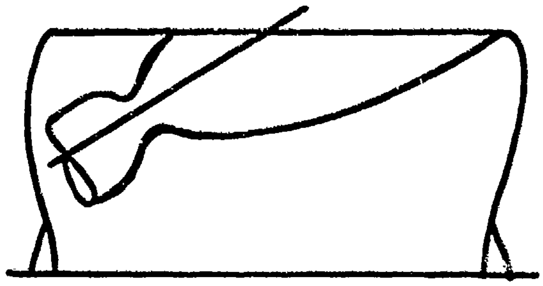
In some applications, such as a nozzle exiting through the side of a missile where the nozzle axis is not aligned with the missile axis, the nozzle terminates along the line of intersection of the nozzle contour and the missile outer skin. Such a nozzle is called a scarfed nozzle. Figure 1 illustrates several possible scarfed nozzle configurations.

Unbalanced side forces are generated in scarfed nozzles, and the resultant thrust vector does not lie along the nozzle axis or the missile axis. When two or more identical scarfed nozzles are located symmetrically around the missile axis, the resultant thrust vector does lie along the missile axis. However, even in that case the missile axial thrust is reduced below the nozzle axial thrust due to the misalignment of the nozzle axis and the missile axis.

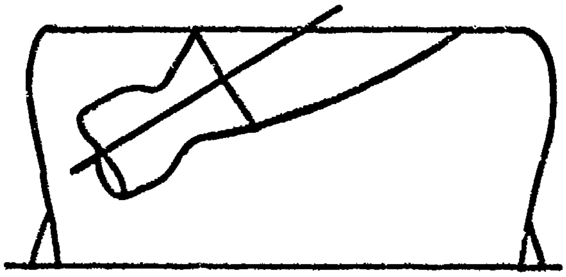
Expansion waves or shock waves, depending on the pressure ratio, emanate from the nozzle exit lip contour as the internal flow leaves the protection of the solid wall and flows into the surrounding



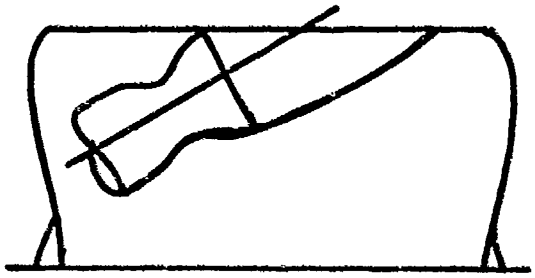
(a) Conical nozzle.



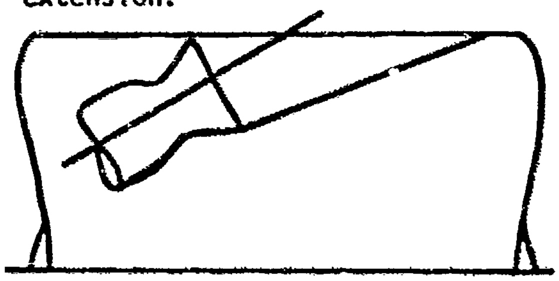
(b) Contoured nozzle.



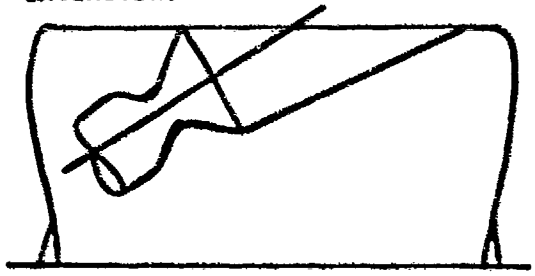
(c) Conical nozzle, contoured extension.



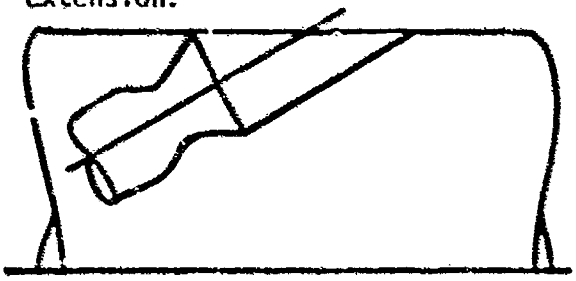
(d) Contoured nozzle, contoured extension.



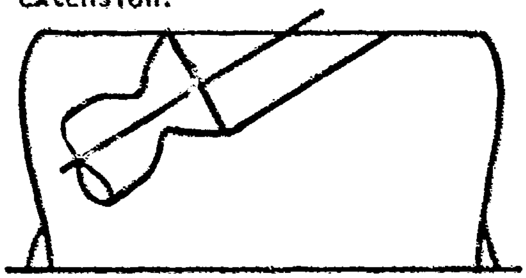
(e) Conical nozzle, conical extension.



(f) Contoured nozzle, conical extension.



(g) Conical nozzle, cylindrical extension.



(h) Contoured nozzle, cylindrical extension.

Figure 1. Several possible scarfed nozzle configurations.

atmosphere. When scarfing is not too severe, the waves emanating from the top of the nozzle at the initial point of scarfing do not intersect the opposite wall, and the portion of the flowfield affecting the pressure on the nozzle wall remains axisymmetric. That is the case considered in the present analysis. When scarfing is severe, the aforementioned waves intersect the opposite wall, and the flow downstream of that intersection is fully three-dimensional. That case is not considered in the present analysis.

The present report presents an analysis, and a computer program for implementing that analysis, for determining the performance of scarfed axisymmetric propulsive nozzles when the scarfing is small enough so that the portion of the flowfield affecting the pressure on the nozzle wall remains axisymmetric.

SECTION II

NOZZLE GEOMETRIC MODEL

1. INTRODUCTION

Several scarfed nozzle configurations are illustrated in Figure 1. Six specific nozzle configurations are considered in the present study. These configurations are illustrated in Figure 2.

Figure 2(a) illustrates a scarfed conical nozzle, where the nozzle contour is specified analytically as a straight line.

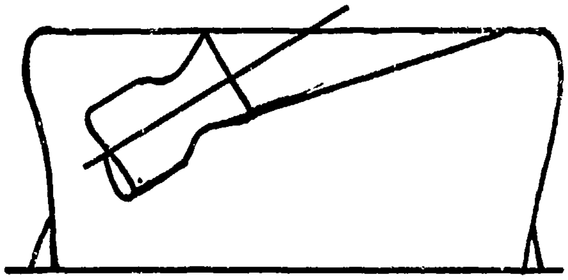
$$y = a + bx \tag{1}$$

Figure 2(b) illustrates a conical nozzle, specified by equation (1), followed by a scarfed conical extension starting at the end of the conical nozzle, where the nozzle extension is specified analytically as a straight line.

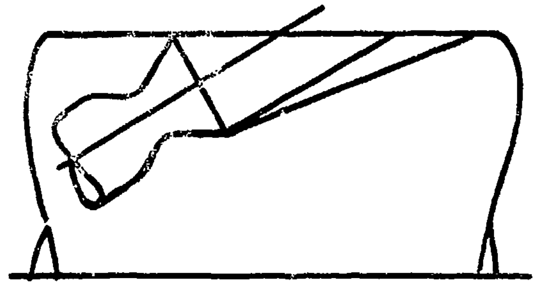
$$y = e + fx \tag{2}$$

When the slope f is zero, a cylindrical extension is obtained.

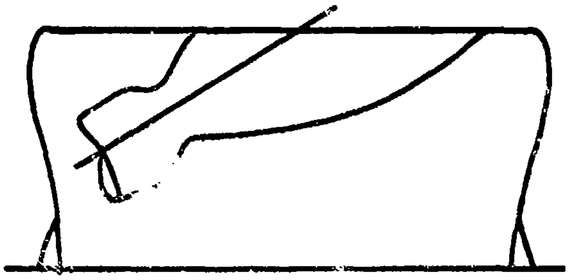
Figure 2(c) illustrates a scarfed quadratic nozzle, where the nozzle contour is specified analytically as a second-order (i.e., quadratic) polynomial.



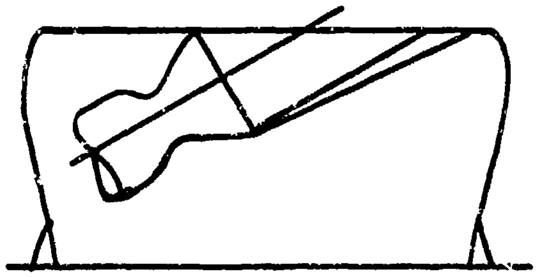
(a) Conical nozzle.



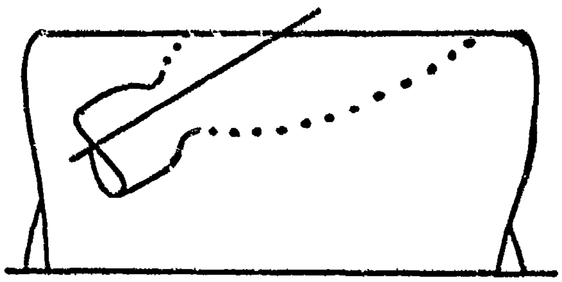
(b) Conical nozzle followed by a conical (or cylindrical) extension.



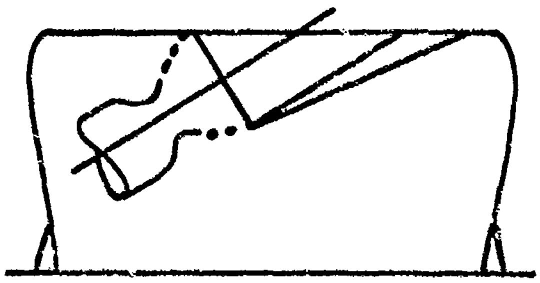
(c) Quadratic nozzle.



(d) Quadratic nozzle followed by a conical (or cylindrical) extension.



(e) Tabular nozzle.



(f) Tabular nozzle followed by a conical (or cylindrical) extension.

Figure 2. Nozzle geometric models considered.

$$y = a + bx + cx^2 \tag{3}$$

Figure 2(d) illustrates a quadratic nozzle, specified by equation (3), followed by a scarfed conical extension starting at the end of the quadratic nozzle, where the nozzle extension is specified by equation (2).

Figure 2(e) illustrates a scarfed tabular nozzle, where the basic nozzle contour is specified in tabular form.

$$y_i = f(x_i), \ (i = 1, \ldots, n) \ \ \underline{\text{tabular}} \tag{4}$$

Figure 2(f) illustrates a tabular nozzle, specified by equation (4), followed by a scarfed conical extension starting at the end of the tabular nozzle, where the nozzle extension is specified by equation (2).

Figure 3 presents a meridional plane view of the geometric model employed for the scarfed nozzle flowfield analysis considered in the present investigation. The nozzle consists of a conventional axisymmetric throat and supersonic expansion contour up to point E where scarfing begins. That portion of the scarfed nozzle is called the <u>basic nozzle</u>. The scarfed section from point E to point F is a conical extension to the basic nozzle. That portion of the scarfed nozzle is called the <u>nozzle extension</u>. In the present analysis, the scarfed section always starts at point E.

The specification of the scarfed nozzle geometry is discussed in in the following paragraphs.

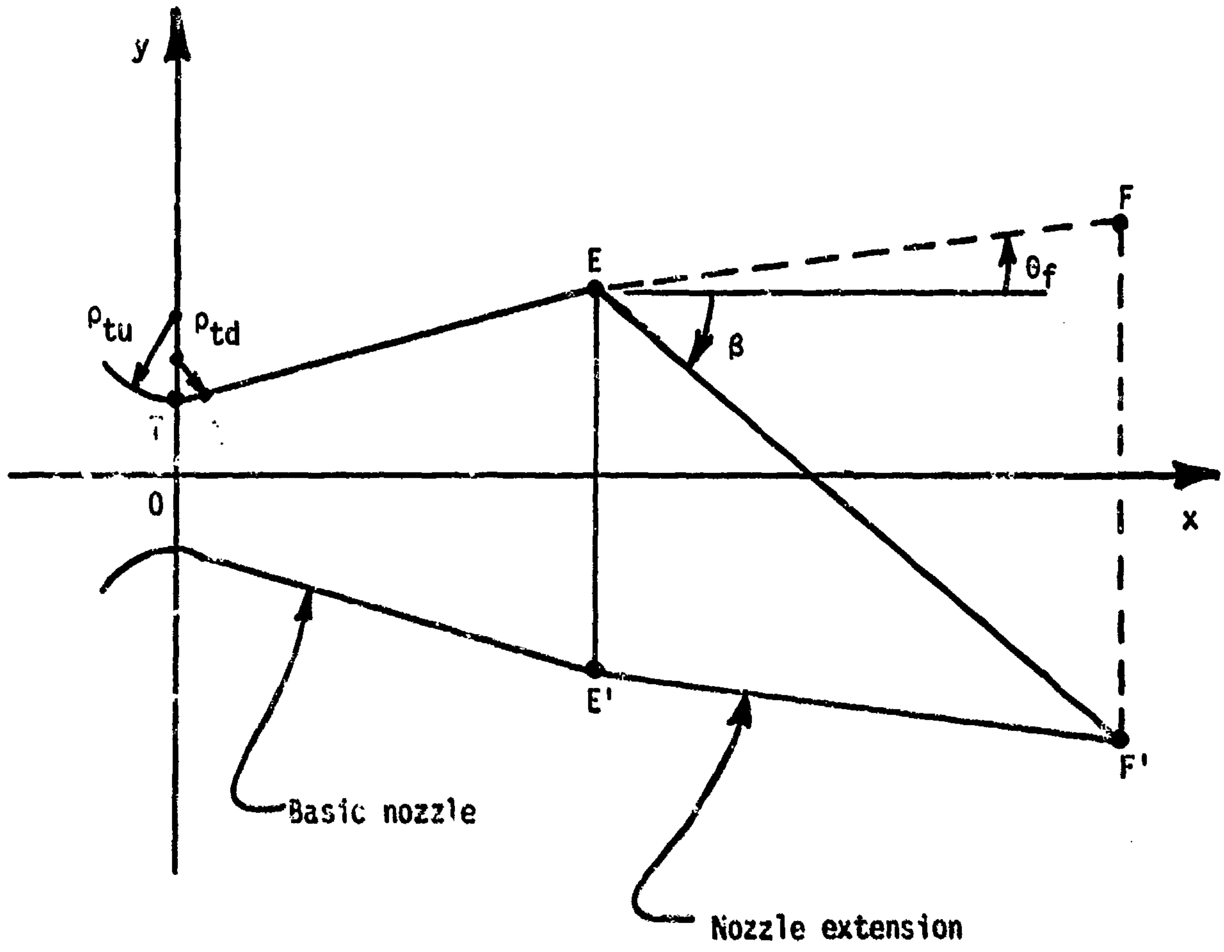


Figure 3. Scarfed nozzle geometric model.

2. BASIC NOZZLE GEOMETRY

The basic nozzle geometry consists of a double circular arc throat contour joined smoothly to a supersonic expansion contour. The supersonic expansion contour can be conical, quadratic, or tabular. The specification of the basic nozzle geometry is discussed in the following paragraphs.

Throat geometry. The throat of the basic nozzle consists of a double circular arc contour that attaches smoothly to the supersonic expansion contour at point A. The throat geometry is completely specified by the throat radius y_t, the upstream throat radius of curvature ρ_{td}, the downstream throat radius of curvature ρ_{td}, and the throat attachment angle θ_a where the supersonic expansion contour attaches smoothly to the circular arc throat contour. The location of point A is determined from the following two equations.

$$x_a = \rho_{td} \sin \theta_a \tag{5}$$

$$y_a = y_t + \rho_{td} (1 - \cos \theta_a) \tag{6}$$

The upstream throat radius of curvature ρ_{td} is used in the calculation of the supersonic initial-value line which spans the nozzle throat from point T to the point on the nozzle centerline where the Mach number is 1.0.

Conical nozzle. When the supersonic expansion contour is conical, the cone angle α must equal the throat attachment angle θ_a. Five

options exist for specifying the conical nozzle contour.

1. Specified throat attachment angle θ_a and nozzle length x_e. In this case, the nozzle exit lip radius y_e is determined from

$$y_e = y_a + (x_e - x_a) \tan \theta_a \tag{7}$$

2. Specified throat attachment angle θ_a and exit lip radius y_e. In this case, the nozzle length x_e is determined from

$$x_e = x_a + (y_e - y_a) / \tan \theta_a \tag{8}$$

3. Specified throat attachment angle θ_a and nozzle area ratio $\varepsilon = (y_e/y_t)^2$. In this case, the nozzle exit lip radius y_e is determined from

$$y_e = y_t\sqrt{\varepsilon} \tag{9}$$

The nozzle length x_e is then determined from equation (8).

4. Specified nozzle length x_e and exit lip radius y_e. The throat attachment angle θ_a is determined from

$$\theta_a = \tan^{-1}\left(\frac{y_e - y_a}{x_e - x_a}\right) \tag{10}$$

5. Specified nozzle length x_e and nozzle area ratio ε. The nozzle exit lip radius y_e is determined from equation (9) and the throat attachment angle θ_a is determined from equation (10).

In all five cases, point A (x_a, y_a), point E (x_e, y_e), and the throat attachment angle θ_a are known. The equation for the supersonic expansion contour is given by

$$y(x) = a + bx \tag{11}$$

where

$$b = \frac{dy(x)}{dx} = \tan\alpha \qquad \text{and} \qquad a = y_a - bx_a \tag{12}$$

<u>Quadratic nozzle</u>. When the supersonic expansion contour is quadratic, the supersonic contour must attach smoothly to the circular arc throat contour, and the nozzle length x_e must be specified. The equation for the supersonic expansion contour is

$$y(x) = a + bx + cx^2 \tag{13}$$

Three options exist for specifying the supersonic expansion contour.

1. Specified throat attachment angle θ_a, nozzle exit lip angle θ_e, and nozzle length x_e. Substituting the three known values (x_a,y_a), (x_a,θ_a), and (x_e,θ_e) into equation (13) and its derivative (i.e., $dy/dx = b + 2cx = \tan\theta$) yields

$$c = \frac{\tan\theta_e - \tan\theta_a}{2(x_e - x_a)} \tag{14}$$

$$b = \tan\theta_a - 2cx_a \tag{15}$$

$$a = y_a - bx_a - cx_a^2 \tag{16}$$

2. Specified throat attachment angle θ_a, nozzle length x_e, and exit lip radius y_e. Substituting the three known values (x_a, y_a), (x_a, θ_a), and (x_e, y_e) into equation (13) yields

$$c = \frac{\left(\dfrac{y_e - y_a}{x_e - x_a}\right) - \tan\theta_a}{x_e - x_a} \tag{17}$$

$$b = \tan\theta_a - 2cx_a \tag{18}$$

$$a = y_a - bx_a - cx_a^2 \tag{19}$$

3. Specified throat attachment angle θ_a, nozzle length x_e, and nozzle area ratio ε. In this case, the nozzle exit lip radius y_e is given by equation (9). The coefficients a, b, and c are given by equations (17) to (19).

Tabular nozzle. If the supersonic expansion contour is tabular, a set of (x,y) pairs spanning the region from point A to point E must be specified. These points must be chosen so that a smooth transition to the circular arc throat contour is obtained. The first point in the table is a point just downstream of the throat attachment point, point A. The last point in the table specifies the nozzle exit lip point, point E.

3. NOZZLE EXTENSION GEOMETRY

The nozzle extension consists of a conical section beginning at the end of the basic nozzle, point E in Figure 3, and ending at point F. The scarfing angle β is the angle, in the meridional plane, between the nozzle axis and the missile axis. For a conventional propulsive nozzle, the scarfing angle β is zero. In general, the intersection of a body of revolution such as the nozzle contour with a second body of revolution such as the missile outer envelope will not yield a curve of intersection that lies within a plane. However, if the diameter of the missile is much larger than the diameter of the nozzle, the curve of intersection lies in a surface that approaches a plane as the diameter of the missile increases. In the present analysis, the curve of intersection is assumed to lie in a plane.

The geometry of the nozzle extension is completely specified by the attachment point (x_e, y_e), the angle of the conical extension θ_f, and the length of the conical extension x_f.

If the nozzle extension attaches smoothly to the basic nozzle (i.e., $\theta_e = \theta_f$), then a continous flow occurs across the transition region. If θ_f is less than θ_e, then an oblique shock wave emanates from point E and propagates downstream in the nozzle extension. Both possibilities are accounted for in the present analysis. If θ_f is greater than θ_e, then a centered expansion wave emanates from point E and propagates downstream in the nozzle extension. That possibility is not considered in the present analysis.

SECTION III

FLOWFIELD MODEL

1. INTRODUCTION

The flowfield model consists of four parts.

(a) The transonic flow analysis in the throat region of the basic nozzle.

(b) The supersonic flow analysis in the basic nozzle.

(c) The determination of the shock wave (or Mach line if $\theta_e = \theta_f$) which emanates from the point of attachment of the nozzle extension to the basic nozzle (point E in Figure 3) and propagates downstream into the nozzle extension.

(d) The supersonic flow analysis in the nozzle extension downstream of the oblique shock wave.

The specification of these four flowfield models is presented in the following paragraphs.

The flow is assumed to originate upstream of the nozzle in a uniform flow region having constant stagnation pressure and temperature P_t and T_t, respectively. The flowing fluid is assumed to be a thermally and calorically perfect gas (i.e., constant molecular weight and specific heats). The presence of condensed phases and chemical reactions are neglected, and boundary layer effects are considered negligible. Consequently, the flowfield is isentropic everywhere except within the oblique shock wave, which is described by the standard oblique shock wave relationships.

The flowfield in the transonic region and in the basic nozzle is irrotational (i.e., constant entropy and stagnation enthalpy throughout) since the flow originates in a uniform flow region and is isentropic. The flowfield is rotational downstream of the oblique shock wave due to the entropy gradient produced by the curved oblique shock wave.

The overall numerical algorithm is discussed in detail in Section V. A brief introduction to the overall numerical algorithm is presented here to identify the various flowfield models that are required to determine the performance of a scarfed propulsive nozzle.

The flow in the throat region of the nozzle is assumed to be completely specified by a perturbation analysis that depends only on the geometry of the nozzle throat. From this analysis, the flow properties along an initial-value line spanning the nozzle throat are determined, as illustrated in Figure 4.

Right-running Mach lines are then emanated from each point along the initial-value line, starting with the points adjacent to the axis, and continued until they intersect the nozzle axis. The last such right-running Mach line emanating from the nozzle throat wall point defines the extent of the initial-value problem. This region is illustrated in Figure 5.

Point locations are prespecified along the circular arc initial expansion contour downstream of the nozzle throat wall point. A right-running Mach line is emanated from each prespecified wall point and continued until it intersects the nozzle axis. The last such right-running Mach line defines the extent of the initial expansion flowfield. This region is illustrated in Figure 6.

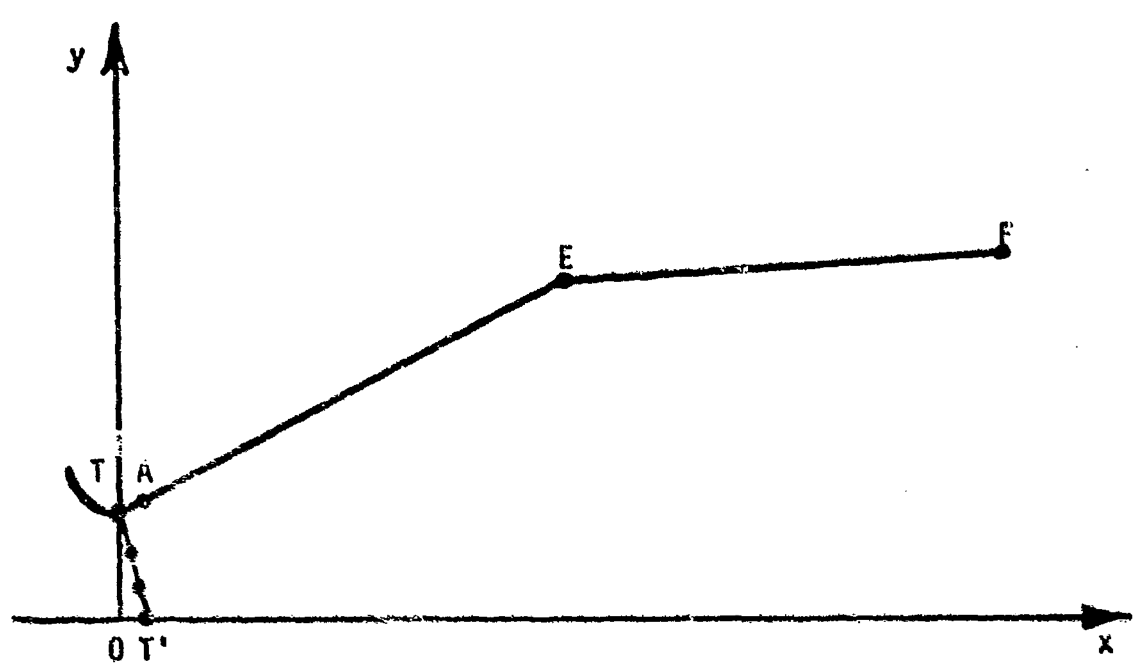


Figure 4. Initial-value line.

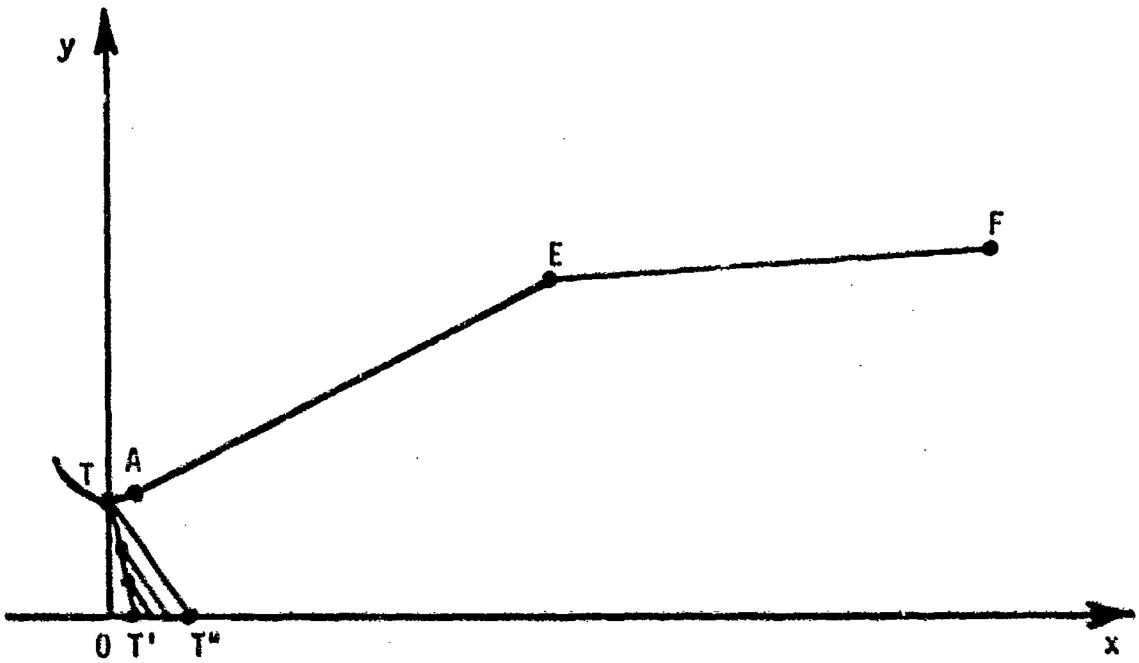


Figure 5. Extent of the initial-value problem.

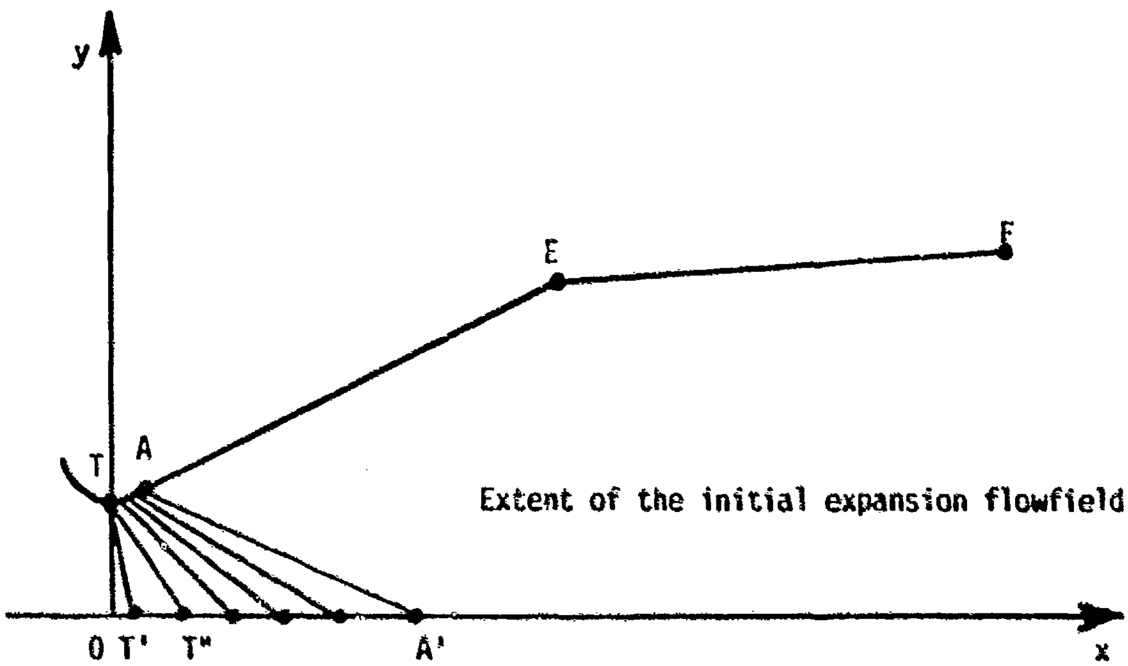


Figure 6. Flowfield from the initial expansion contour.

Left-running Mach lines are then emanated from each point along the last right-running Mach line in the initial expansion flowfield and continued until they intersect the nozzle wall. The first such left-running Mach line begins at the first interior point on the aforementioned right-running Mach line, the second left-running Mach line begins from the second interior point, and so on. This process is continued until either the end of the basic nozzle is reached, or the last point on the right-running Mach line, which lies on the nozzle axis, has been reached. In this latter case, left-running Mach lines are emanated from the nozzle axis and continued until they intersect the nozzle wall. In either case, a left-running Mach line will eventually reach the end of the basic nozzle contour, point E. This flowfield is illustrated in Figure 7.

Due to the finite change in wall slope at point E, an oblique shock wave forms at that point. That right-running shock wave propagates into the flowfield and intersects the left-running Mach lines as they propagate toward the wall. The flowfield up to the shock wave is irrotational, and the flowfield downstream of the shock wave is rotational. The flow property changes across the shock wave depend on the strength of the shock wave, which is determined by both the upstream flowfield and the downstream flowfield. After passing through the oblique shock wave, the left-running Mach lines continue until they intersect the scarfed nozzle extension. This process is continued until the end of the scarfed nozzle extension, point F, is reached. This flowfield is illustrated in Figure 8.

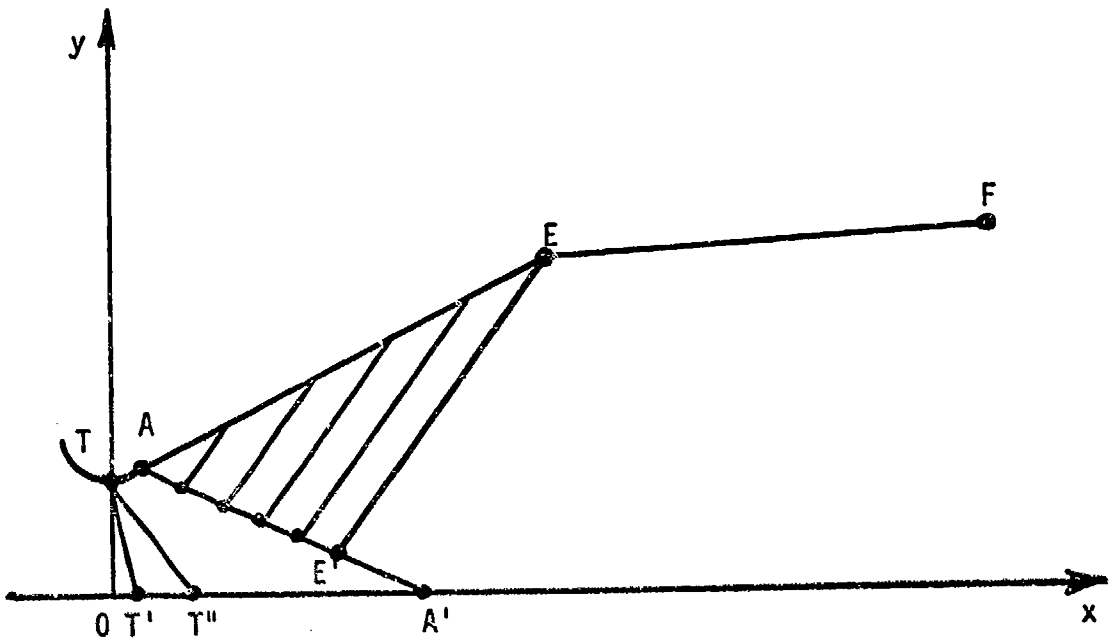


Figure 7. Flowfield in the basic nozzle.

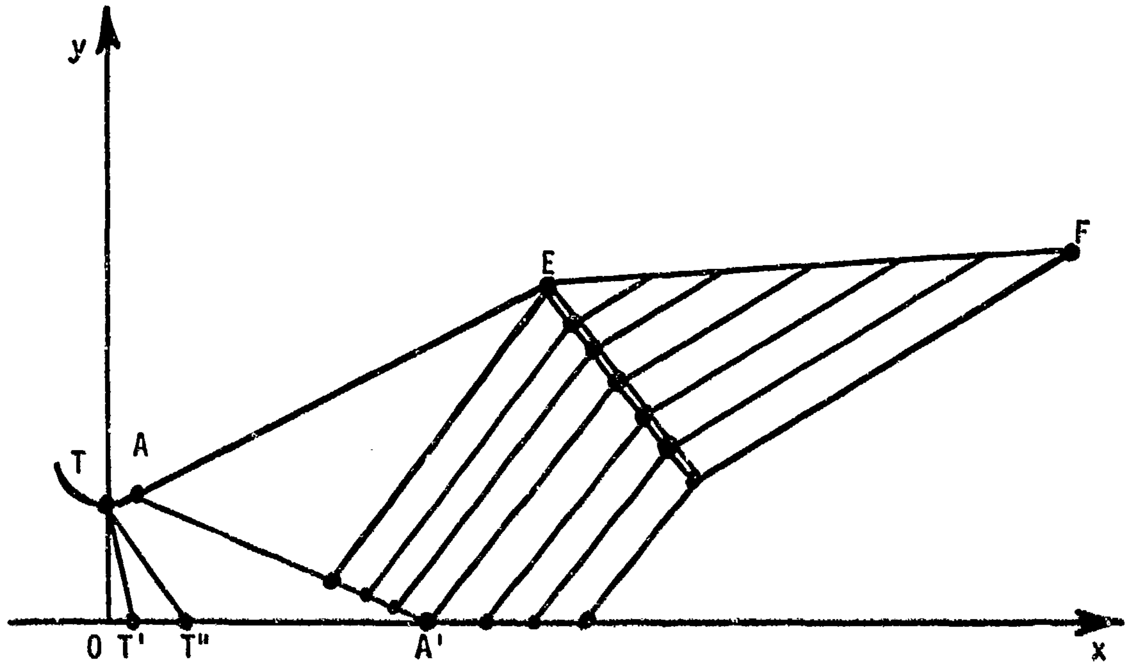


Figure 8. Flowfield in the scarfed nozzle extension.

Once the entire scarfed nozzle flowfield has been calculated as described above, the performance of the scarfed nozzle can be computed. That computation is described in Section IV.

2. TRANSONIC FLOW MODEL

A. FLOWFIELD

The flowfield in the transonic throat region of the basic nozzle is assumed to be completely determined by the geometry of the nozzle throat. The influence of the upstream subsonic geometry is assumed to be negligible. This is a good approximation when the nozzle inlet is "well behaved." Figure 9 illustrates the throat geometry.

As illustrated in Figure 9, the sonic line originates on the nozzle wall upstream of the throat (point T), spans the throat region, and intersects the nozzle axis downstream of the throat. When the throat upstream radius of curvature ρ_{tu} is large compared to the throat radius y_t, linearized flow analyses give reasonable predictions for the transonic flowfield. Zucrow and Hoffman (1) present a discussion of such analyses.

In the present case, the analysis developed by Kliegel and Levine (2) is employed. The velocity components u and v in the x and y directions, respectively, are given by

$$\frac{u(x,y)}{a^*} = 1 + \frac{u_1(\bar{x},\bar{y})}{(R+1)} + \frac{1}{(R+1)^2}[u_1(\bar{x},\bar{y}) + u_2(\bar{x},\bar{y})] + \frac{1}{(R+1)^3}[u_1(\bar{x},\bar{y}) + 2u_2(\bar{x},\bar{y}) + u_3(\bar{x},\bar{y})] \tag{20}$$

$$\frac{v(\bar{x},\bar{y})}{a^*} = \left[\frac{\gamma+1}{2(R+1)}\right]^{1/2}\left\{\frac{v_1(\bar{x},\bar{y})}{(R+1)} + \frac{1}{(R+1)^2}\left[\frac{3}{2}v_1(\bar{x},\bar{y}) + v_2(\bar{x},\bar{y})\right] + \frac{1}{(R+1)^3}\left[\frac{15}{8}\ v_1(\bar{x},\bar{y}) + \frac{5}{2}v_2(\bar{x},\bar{y}) + v_3(\bar{x},\bar{y})\right]\right\} \tag{21}$$

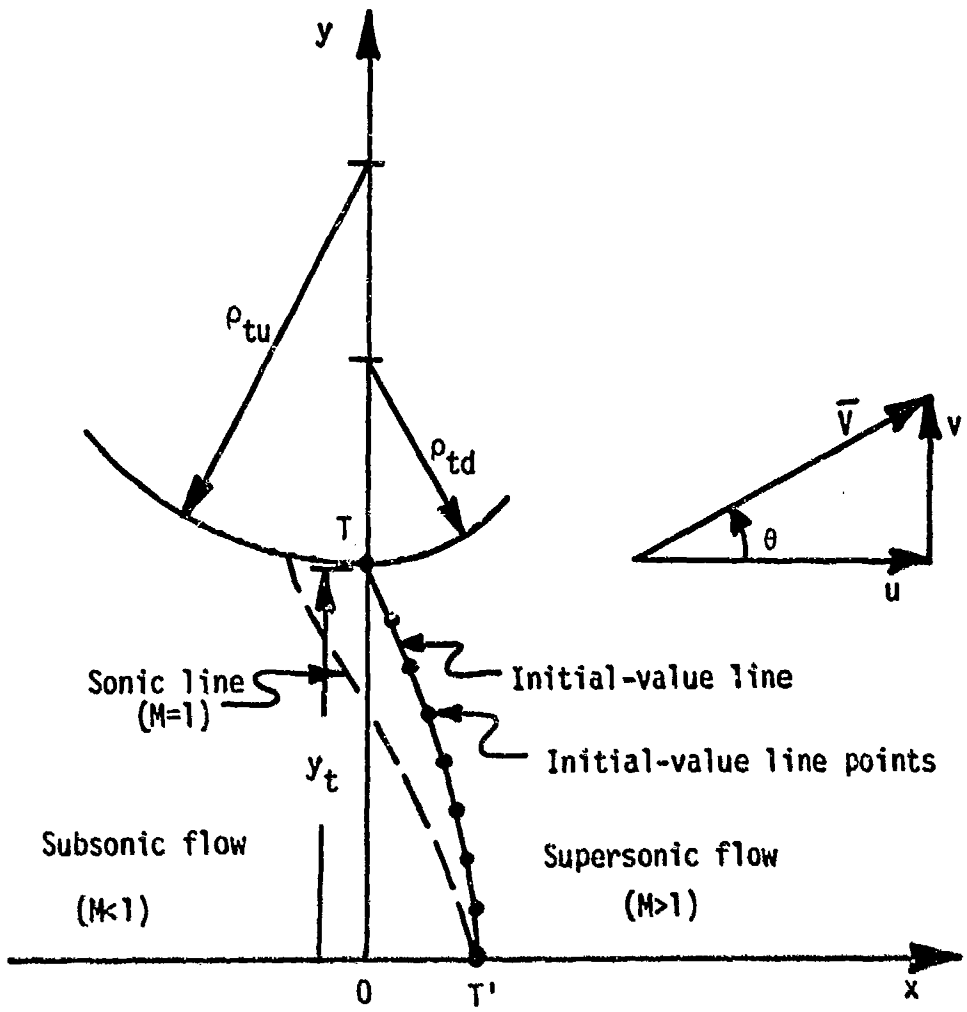


Figure 9. Nozzle throat geometry

where

$$a^* = (\gamma RT^*)^{1/2} = \left(\frac{2\gamma RT_t}{\gamma+1}\right)^{1/2} \tag{22}$$

$$R = \frac{\rho_{tu}}{y_t},\ \bar{x} = \left(\frac{2R}{\gamma+1}\right)^{1/2} \frac{x}{y_t},\ \bar{y} = \frac{y}{y_t} \tag{23}$$

T_t is the stagnation temperature, γ and R are the gas specific heat ratio and gas constant, respectively, and $u_1(\bar{x},\bar{y})$, etc., are polynomial expressions in $\bar{x}$ and $\bar{y}$ given by equations (15.100) to (15.105) in Reference (1).

In the present analysis, the initial-value line is a parabola extending from the nozzle throat wall point, point T in Figure 9, to the point on the nozzle axis where M = 1.0, as illustrated in Figure 9. The particular parabola employed is the curve along which the flow angle θ [$\theta = \tan^{-1}(v/u)$] is equal to zero in Sauer's linearized flow analysis [Reference (3), see also Reference (1)]. That parabola is specified by

$$x = \varepsilon - \frac{(\gamma+1)\alpha y^2}{2(3+\delta)} \tag{24}$$

where $\delta = 0$ denotes planar flow, $\delta = 1$ denotes axisymmetric flow, and

$$\varepsilon = -\frac{y_t}{2(3+\delta)}\left[\frac{(\gamma+1)(1+\delta)}{(\rho_{tu}/y_t)}\right]^{1/2} \tag{25}$$

$$\alpha = \left[\frac{1+\delta}{(\gamma+1)\rho_{tu}y_t}\right]^{1/2} \tag{26}$$

The initial-value line is determined by specifying the y coordinates of NI points across the throat, and calculating the corresponding values of x from equation (24). Figure 10 illustrates a typical result. These sets of (x,y) pairs are substituted into equations (20) and (21) to determine the velocity components u(x,y) and v(x,y). Then the velocity magnitude V is determined from

$$V = (u^2 + v^2)^{1/2} \tag{27}$$

From the energy equation for the adiabatic flow of a thermally and calorically perfect gas [see Reference (4)],

$$T = T_t - \frac{V^2}{2c_p} \tag{28}$$

where c_p is the constant pressure specific heat. The speed of sound a is given by

$$a = (\gamma RT)^{1/2} \tag{29}$$

and the Mach number M is defined as

$$M = \frac{V}{a} \tag{30}$$

From the definition of the stagnation pressure P_t for a thermally and calorically perfect gas [see Reference (4)],

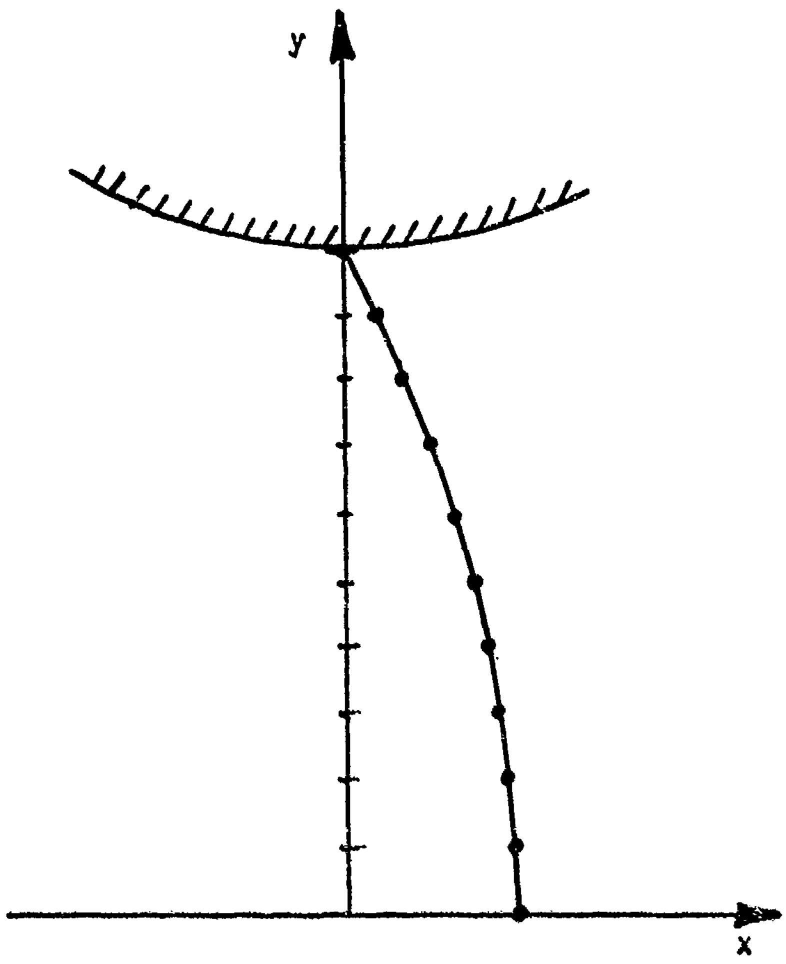


Figure 10. Supersonic initial-value line.

$$P = P_t\left(\frac{T}{T_t}\right)^{\frac{\gamma}{\gamma-1}} \tag{31}$$

From the thermal equation of state, the density ρ is given by

$$\rho = \frac{P}{RT} \tag{32}$$

Thus, all the flow properties along the initial-value line have been determined.

B. PERFORMANCE PARAMETERS

The nozzle mass flow rate $\dot{m}$ is obtained by numerically integrating the differential mass flow rate $d\dot{m}$ across the initial-value line (IVL). Thus,

$$d\dot{m} = \rho u 2\pi y dy - \rho v 2\pi y dx \tag{33}$$

$$\dot{m} = \int_{IVL} d\dot{m} \tag{34}$$

The nozzle discharge coefficient C_D is defined as

$$C_D = \frac{\dot{m}}{\dot{m}_{1-D}} \tag{35}$$

where the reference ideal one-dimensional isentropic choked mass flow rate $\dot{m}_{1-D}$ is given by [see Reference (4)]

$$\dot{m}_{1\text{-}D} = \frac{\Gamma P_t A_t}{(\gamma R T_t)^{1/2}} \tag{36}$$

where the parameter Γ is defined as

$$\Gamma = \gamma \left(\frac{2}{\gamma+1}\right)^{\frac{\gamma+1}{2(\gamma-1)}} \tag{37}$$

The initial-value line thrust F_{IVL} is the sum of the axial components of the pressure forces and the momentum flux across the initial-value line. Thus,

$$dF = (P - P_a)\ 2\pi y\ dy + u\ d\dot{m} \tag{38}$$

$$F = \int_{IVL} dF \tag{39}$$

where P_a is the atmospheric pressure. The thrust efficiency η_F is defined as

$$\eta_F = \frac{F}{F_{1\text{-}D}} \tag{40}$$

where the reference ideal one-dimensional isentropic choked thrust is given by

$$F_{1\text{-}D} = (P^* - P_a)\ A_t + a^*\ \dot{m}_{1\text{-}D} \tag{41}$$

where the throat sonic velocity a^* is given by equation (22) and the

throat choking pressure P^* is given by [see Reference (4)]

$$P^* = P_t \left(\frac{2}{\gamma+1}\right)^{\frac{\gamma}{\gamma-1}} \tag{42}$$

The initial-value line specific impulse I_{sp} is defined as

$$I_{sp} = \frac{F}{\dot{m}} \tag{43}$$

The specific impulse efficiency η_I is defined as

$$\eta_I = \frac{I_{sp}}{I_{sp,1-D}} \tag{44}$$

where the reference ideal one-dimensional specific impulse is defined as

$$I_{sp,1-D} = \frac{F_{1-D}}{\dot{m}_{1-D}} \tag{45}$$

By combining equations (35), (40), and (44), it is obvious that

$$\eta_F = C_D\, \eta_I \tag{46}$$

The above analysis completely determines all of the properties of interest along the supersonic initial-value line. Some numerical examples are presented in Reference (1).

3. IRROTATIONAL FLOW MODEL

A. GOVERNING EQUATIONS

The portion of the supersonic flowfield between the supersonic initial-value line and the oblique shock wave emanating from the wall discontinuity where the basic nozzle and the nozzle extension meet (i.e., point E) is an irrotational flowfield. The basic equations governing an adiabatic inviscid flow are the continuity equation, the Euler momentum equations, and the energy equation. These equations are derived in Reference (5). For steady two-dimensional flow, those equations are

$$\rho u_x + \rho v_y + u\rho_x + v\rho_y + \frac{\delta \rho v}{y} = 0 \tag{47}$$

$$\rho u u_x + \rho v u_y + P_x = 0 \tag{48}$$

$$\rho u v_x + \rho v v_y + P_y = 0 \tag{49}$$

$$u h_x + v h_y + u\left(\frac{V^2}{2}\right)_x + v\left(\frac{V^2}{2}\right)_y = 0 \tag{50}$$

where $\delta = 0$ for planar flow and $\delta = 1$ for axisymmetric flow, and h is the enthalpy of the fluid. For isentropic (i.e., adiabatic and frictionless) flows, it is convenient to replace the energy equation, equation (50), by the speed of sound equation [see Reference (5)] to eliminate the enthalpy h from the system of equations. That equation is

$$uP_x + vP_y - a^2(u\rho_x + v\rho_y) = 0 \tag{51}$$

Combining equations (47) and (51) to eliminate the derivatives of density yields

$$\rho a^2(u_x + v_y + \frac{\delta v}{y}) + uP_x + vP_y = 0 \tag{52}$$

Equations (47), (48), (49), and (52) comprise a set of four coupled partial differential equations for determining the four flow properties u, v, P, and ρ. Those equations are the basis of the rotational flow model employed downstream of the oblique shock wave. That flow model is developed further in Section III.5.

If the flowfield originates in a region of parallel uniform flow and remains isentropic, then the vorticity of the flowfield is everywhere zero [see Reference (5)]. Thus,

$$\bar{\zeta} = \nabla x \bar{V} = 0 \tag{53}$$

which, for two-dimensional flow, gives

$$u_y - v_x = 0 \tag{54}$$

A single equation containing derivatives only of u and v can be obtained by multiplying equations (48) and (49) by u and v, respectively, adding them together, and subtracting equation (52). The result

is

$$\rho(u^2 - a^2)u_x + \rho(v^2 - a^2)v_y + \rho uv(u_y + v_x) - \frac{\delta \rho a^2 v}{y} = 0 \qquad (55)$$

Dividing by the density ρ and introducing equation (54) gives

$$(u^2 - a^2)u_x + (v^2 - a^2)v_y + 2uvu_y - \frac{\delta a^2 v}{y} = 0 \qquad (56)$$

Equation (56) is sometimes called the gasdynamic equation. When considered in conjunction with equation (54), the irrotationality condition, a set of two partial differential equations is obtained for determining the two velocity components u and v. The remaining flow properties (i.e., V, T, P, ρ, and M) can be determined as discussed in Section III.2 for transonic flow.

The flow model employed for the irrotational flowfield between the nozzle throat and the oblique shock wave consists of equations (56) and (54), which are repeated and renumbered below.

$$(u^2 - a^2)u_x + (v^2 - a^2)v_y + 2uvu_y - \frac{\delta a^2 v}{y} = 0 \qquad (57)$$

$$u_y - v_x = 0 \qquad (58)$$

B. METHOD OF CHARACTERISTICS

In the present analysis, equations (57) and (58) are solved by the numerical method of characteristics. Characteristics are curves in the solution space (i.e., the xy plane) along which the partial differential

equations combine to form ordinary differential equations. That is, the partial differential equations become directional derivatives along the characteristic curves. The basic principles of the method of characteristics are discussed in Reference (6). Application of the method of characteristics to steady two-dimensional irrotational supersonic flow is discussed in Reference (7). A brief summary of those results is presented below.

C. CHARACTERISTIC EQUATIONS

For steady two-dimensional irrotational supersonic flow, two families of characteristic curves exist; the left-running and right-running Mach lines. The slope λ of a characteristic curve is defined as

$$\frac{dy}{dx} = \lambda \tag{59}$$

A quadratic equation can be found for determining λ. As shown in Reference (6), that equation is

$$(u^2 - a^2)\lambda^2 - 2uv\lambda + (v^2 - a^2) = 0 \tag{60}$$

Solving equation (60) for λ yields

$$\lambda_\pm = \left(\frac{dy}{dx}\right)_\pm = \frac{uv \pm a^2\sqrt{M^2-1}}{u^2 - a^2} \tag{61}$$

Equation (61) can be simplified using the definitions

$$u = V\cos\theta,\ v = V\sin\theta,\ \theta = \tan^{-1}(v/u),\ \alpha = \sin^{-1}(1/M) \tag{62}$$

where θ is the flow angle and α is the Mach angle. After considerable manipulation, the following result is obtained.

$$\left(\frac{dy}{dx}\right)_{\pm} = \lambda_{\pm} = \tan(\theta \pm \alpha) \tag{63}$$

Equation (63), which defines the characteristic curves, is called the characteristic equation. The subscript + denotes the C_+ characteristic, or left-running Mach line, so called because it runs off to the left of the streamline when looking in the downstream direction. Similarly, the subscript - denotes the C_- characteristic, or right-running Mach line. Figure 11 illustrates these characteristic curves, or Mach lines, at a point in a flowfield. Two Mach lines pass through every point in a flowfield, resulting in two infinite families of left-running and right-running Mach lines.

D. COMPATIBILITY RELATIONS

Equations (57) and (58), when combined and written as directional derivatives along the Mach lines, yield a single ordinary differential equation, called the compatibility relation, which is valid along each family of Mach lines. Consider any continuous function f(x,y). The total derivative of f is given by

$$df = f_x\,dx + f_y\,dy \tag{64}$$

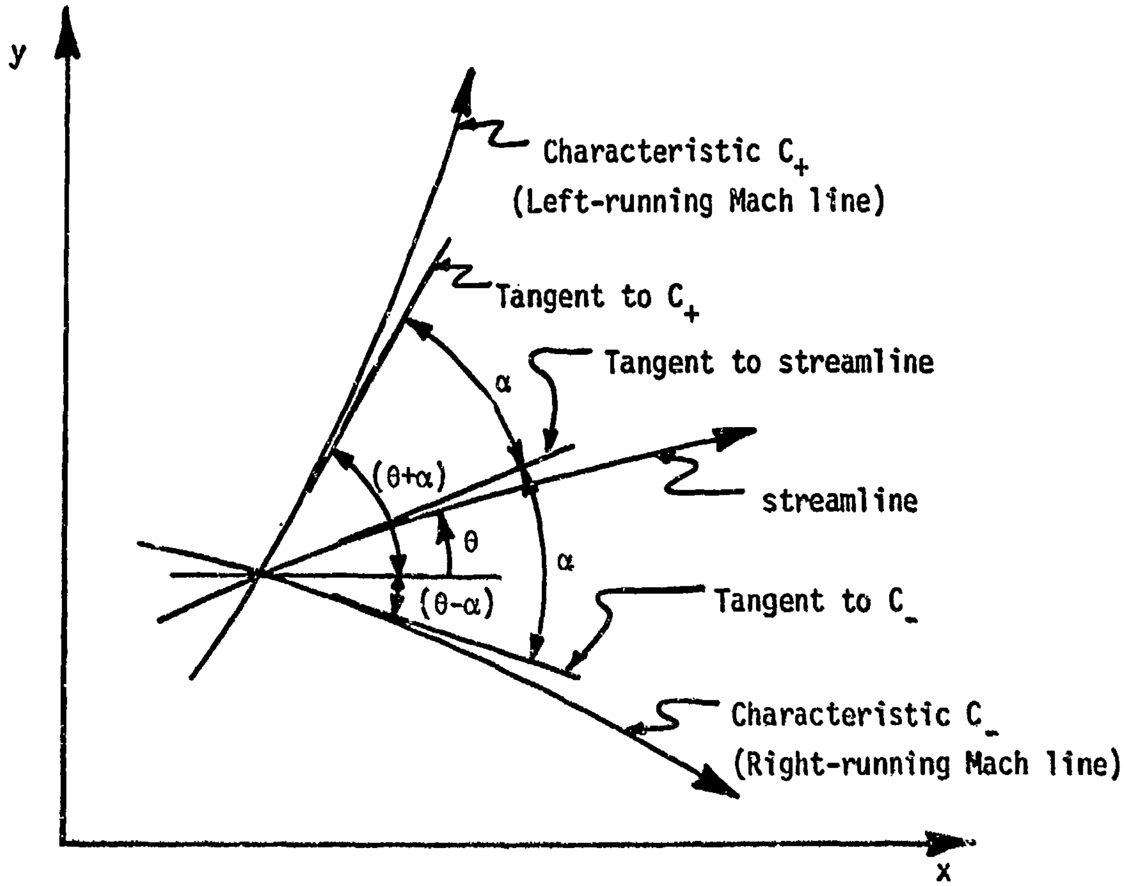


Figure 11. Characteristic curves for irrotational flow.

which may be written as

$$\frac{df}{dx} = f_x + f_y \frac{dy}{dx} = f_x + \lambda f_y \tag{65}$$

The partial derivatives in equations (57) and (58) can be put in the form of equation (65) by multiplying equation (58) by the term

$$(u^2 - a^2)\lambda - 2uv \tag{66}$$

and adding the result to equation (57) to obtain

$$\begin{aligned}(u^2 - a^2)u_x + (v^2 - a^2)v_y + 2uvu_y - \frac{\delta a^2 v}{y} + \\ [(u^2 - a^2)\lambda - 2uv](u_y - v_x) = 0\end{aligned} \tag{67}$$

Rearranging equation (67) yields

$$\begin{aligned}(u^2 - a^2)[u_x + \lambda u_y] + [2uv - (u^2 - a^2)\lambda]\, v_x + \\ (v^2 - a^2)v_y - \frac{\delta a^2 v}{y} = 0\end{aligned} \tag{68}$$

From equation (60),

$$(v^2 - a^2) = [2uv - (u^2 - a^2)\lambda]\,\lambda \tag{69}$$

Substituting equation (69) into equation (68) gives

$$(u^2 - a^2)\,[u_x + \lambda u_y] + [2uv - (u^2 - a^2)\lambda][v_x + \lambda v_y] - \frac{\delta a^2 v}{y} = 0 \tag{70}$$

The partial derivatives in equation (70) are in the form of equation (65). Consequently, equation (70) may be written as

$$(u^2 - a^2)du + [2uv - (u^2 - a^2)\lambda]dv - \frac{\delta a^2 v}{y}dx = 0 \tag{71}$$

Equation (71) is a total differential equation which is valid along the Mach lines. It is called the compatibility relation. When applied along both left-running and right-running Mach lines, equation (71) yields two equations for determining changes in u and v along the two families of Mach lines.

E. SUMMARY OF RESULTS

In summary, for steady two-dimensional irrotational supersonic flow, the characteristic equations are

$$\left(\frac{dy}{dx}\right)_\pm = \lambda_\pm = \tan\,(\theta \pm \alpha) \tag{72}$$

and the compatibility relations are

$$(u^2 - a^2)\,du_\pm + [2uv - (u^2 - a^2)\,\lambda_\pm]dv_\pm - \frac{\delta a^2 v}{y}\,dx_\pm = 0 \tag{73}$$

F. NUMERICAL METHOD OF CHARACTERISTICS

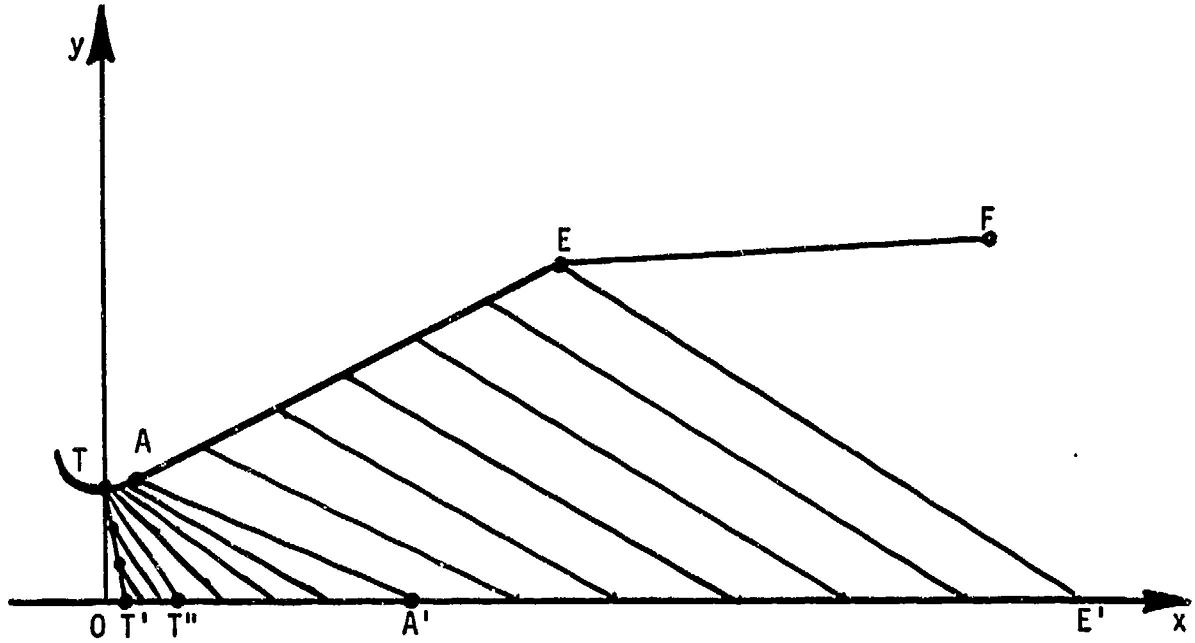
The characteristic equations and compatibility relations for steady

two-dimensional irrotational supersonic flow are presented in the preceding section. Those equations are ordinary differential equations. They can be integrated numerically by the second-order accurate modified-Euler predictor-corrector method. Such a procedure is called the numerical method of characteristics. The details of its implementation are presented in References (6) and (7). That is the procedure employed to calculate the flowfield between the throat of the basic nozzle and the oblique shock wave at the entrance to the scarfed extension.

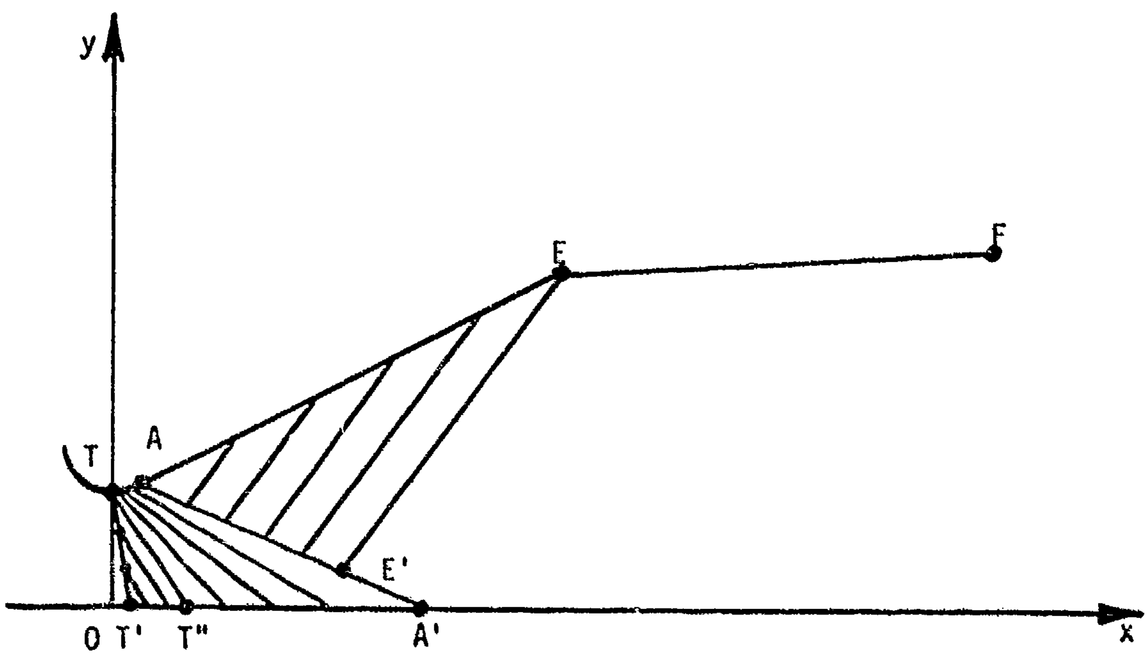
The basic procedure is to start from a supersonic initial-value line across the nozzle throat, such as illustrated in Figure 10. The left-running and right-running Mach lines emanating from the initial-value line points are constructed by solving equation (72). The velocity components u and v are determined at the intersections of the Mach lines by solving equation (73). Since equations (72) and (73) are coupled and nonlinear, they must be solved numerically and simultaneously. This procedure defines the interior point unit process. When a left-running Mach line impinges on the nozzle wall, the boundary conditions of known wall location and slope must be applied. A right-running Mach line is reflected into the flowfield from that point of impingement. That procedure defines the wall point unit process. Similarly, when a right-running Mach line reaches the nozzle axis, the boundary conditions of $y = v = 0$ must be applied. A left-running Mach line is reflected into the flowfield from that point of impingement. That procedure defines the axis point unit process.

This procedure is continued until the entire flowfield between the

nozzle throat and the oblique shock wave has been crisscrossed with left-running and right-running Mach lines and the flow properties have been calculated at all the intersections of the two families of Mach lines. A coarse schematic of the resulting Mach line network is illustrated in Figure 12. Figure 12(a) illustrates the Mach line network when right-running Mach lines are used to construct the flowfield. Figure 12(b) illustrates the Mach line network when left-running Mach lines are used to construct the flowfield.



(a) Right-running Mach line network.



(b) Left-running Mach line network.

Figure 12. Mach line network in the basic nozzle.

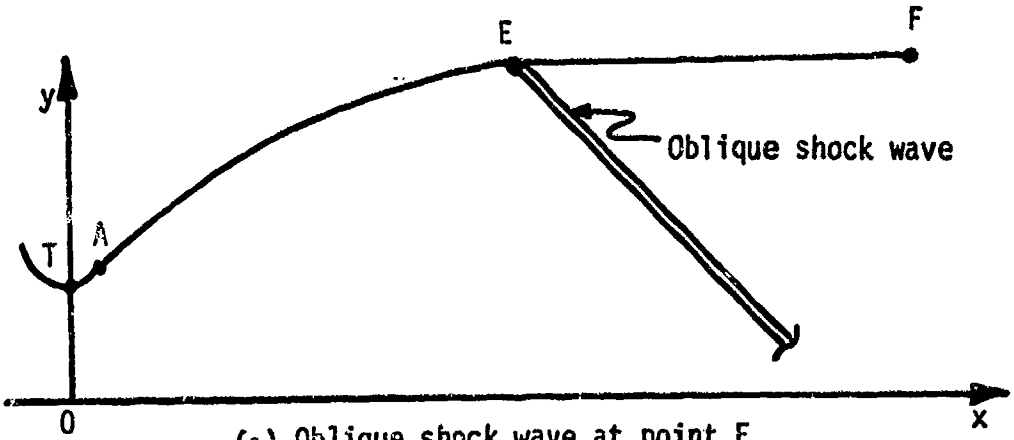
4. SHOCK WAVE MODEL

A. PHYSICAL MODEL

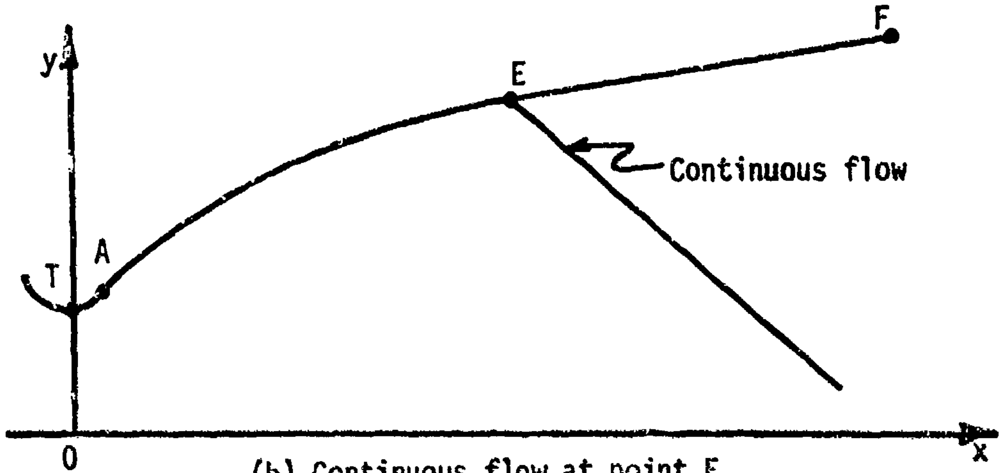
The nozzle geometric model considered in the present investigation consists of a basic nozzle followed by a nozzle extension, as illustrated in Figure 13. As discussed in Section II.1, the basic nozzle may be conical, quadratic, or tabular. The nozzle extension is conical.

At the junction of the basic nozzle and the nozzle extension, the slope of the wall of the basic nozzle may be larger than, equal to, or less than the slope of the nozzle extension, resulting in the generation of an oblique shock wave, a continuous flow, or a centered expansion fan, respectively, as illustrated in Figure 13. The third case, where the slope of the basic nozzle is less than the slope of the nozzle extension, is not considered in the present study. The second case, where the slope of the basic nozzle is equal to the slope of the nozzle extension and the flow is continuous, is treated as the special case of an oblique shock wave of infinitesimal stregth. Consequently, in the present analysis, it is always assumed that an oblique shock wave emanates from the junction of the basic nozzle and the nozzle extension. The flow model for determining the location of and the flow properties across the oblique shock wave are discussed in this section.

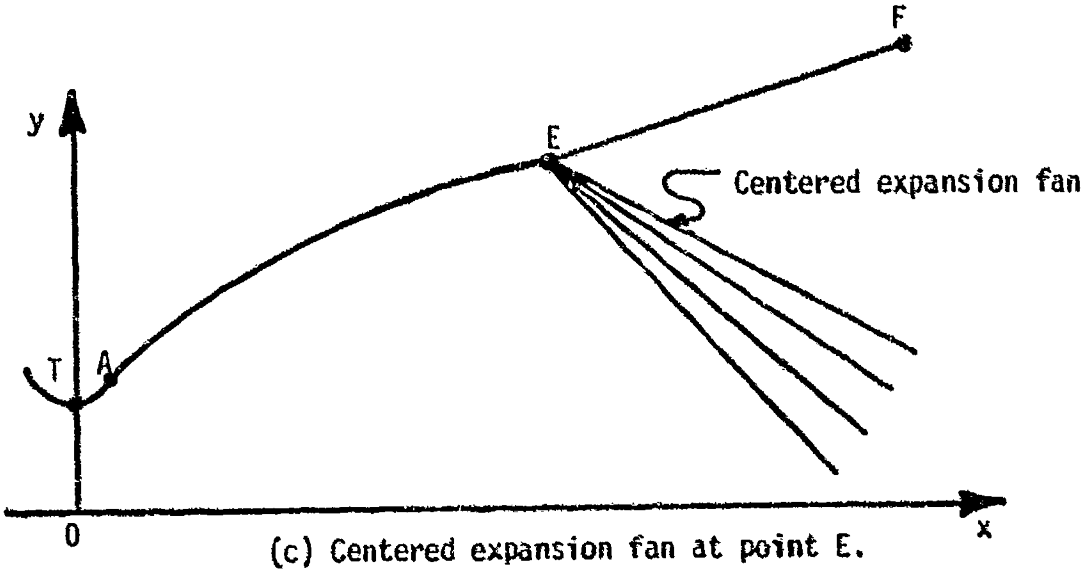
The strength of an oblique shock wave is always greater than a continuous flow. Consequently, the oblique shock emanating from the junction point will propagate upstream into the flowfield determined by the basic nozzle, as illustrated in Figure 14. The strength of the oblique shock wave is influenced by both the upstream flowfield



(a) Oblique shock wave at point E.



(b) Continuous flow at point E.



(c) Centered expansion fan at point E.

Figure 13. Flowfield at point E.

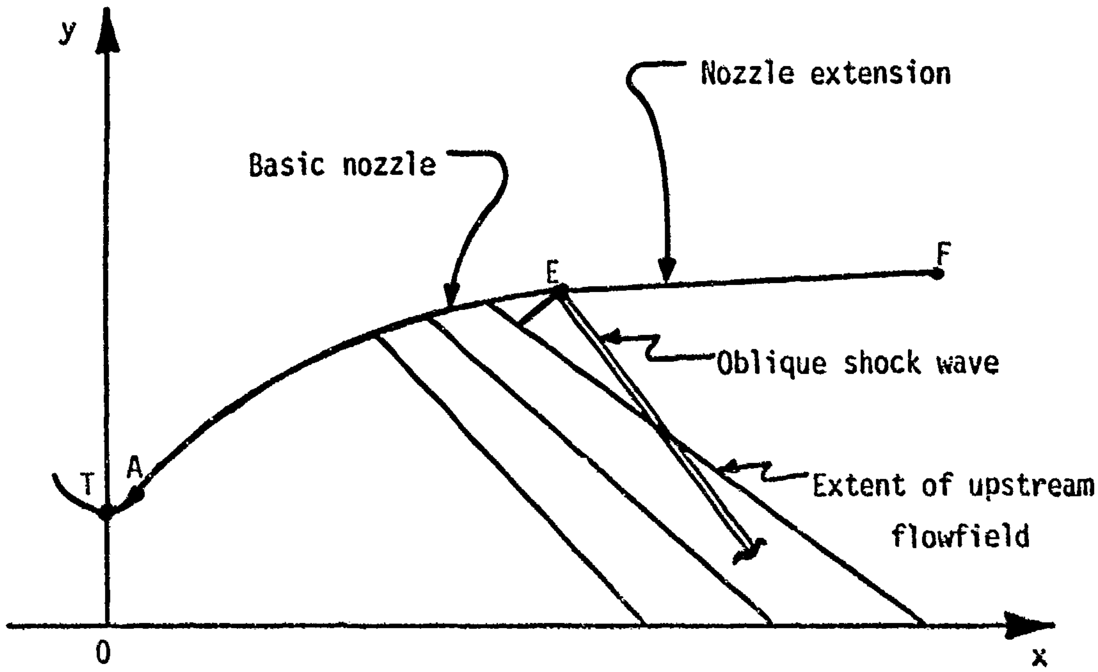


Figure 14. Oblique shock wave.

determined by the basic nozzle and the downstream flowfield determined by the nozzle extension.

B. GOVERNING EQUATIONS

The basic geometry of an oblique shock wave is illustrated in Figure 15. The upstream velocity is denoted by V_1, the flow turning angle between the upstream and downstream flow directions is denoted by δ, and the downstream velocity is denoted by V_2. The shock wave angle is denoted by ε. All of the flow properties (i.e., V, M, P, T, ρ, P_t, and T_t) are known upstream of the oblique shock wave. The problem is to determine the corresponding flow properties downstream of the shock wave for a specified value of the flow turning angle δ. A detailed analysis of the oblique shock wave is presented in Reference (8).

A coordinate system normal and tangential to the oblique shock wave is employed. The equations of continuity, momentum, and energy are applied in that coordinate system. A major conclusion of that analysis is that the tangential component of velocity does not change across the oblique shock wave (i.e., $V_{T1} = V_{T2} = V_T$), and that the components of velocity normal to the shock wave (i.e., V_{N1} and V_{N2}) are governed by the equations for a normal shock wave.

If the wave angle ε is known, the upstream normal Mach number is given by

$$M_{N1} = M_1 \sin \varepsilon \tag{74}$$

From Figure 15, the downstream normal Mach number M_{N2} is given by [see Reference (8)]

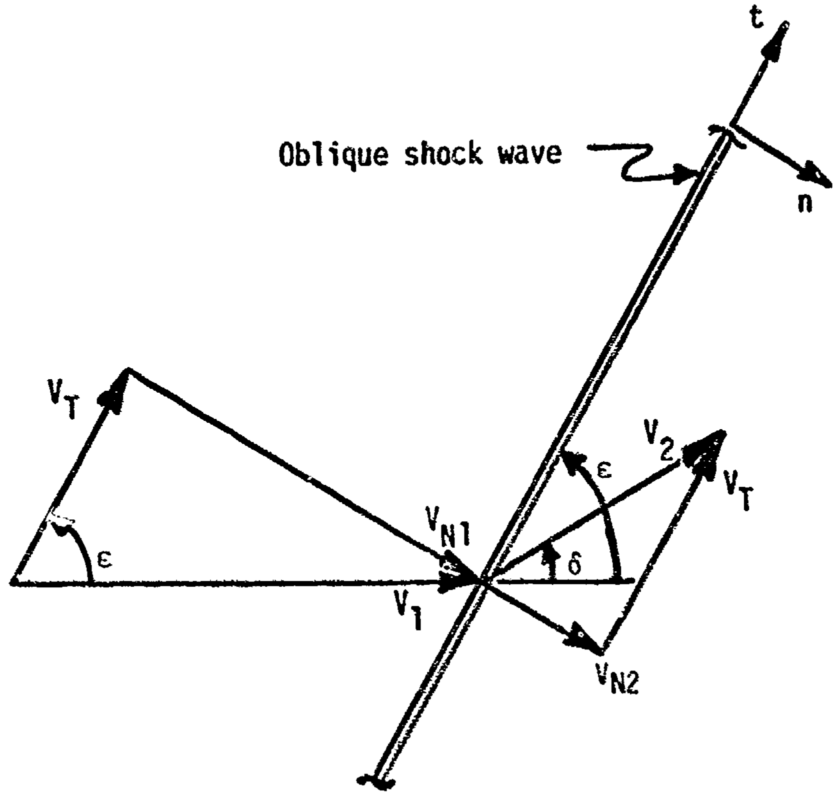


Figure 15. Oblique shock wave geometry.

$$M_{N2} = \left[\frac{1 + \frac{\gamma-1}{2} M_{N1}^2}{\gamma M_{N1}^2 - \frac{\gamma-1}{2}}\right]^{1/2} \tag{75}$$

From Figure 10, the downstream Mach number is

$$M_2 = \frac{M_{N2}}{\sin(\varepsilon-\delta)} \tag{76}$$

For a given wave angle ε, the corresponding flow turning angle δ is given by [see Reference (8)]

$$\frac{1}{\tan\delta} = \left[\frac{\gamma+1}{2} \frac{M_1^2}{M_{N1}^2 - 1} - 1\right]\tan\varepsilon \tag{77}$$

If the flow turning angle δ is specified instead of the wave angle ε, then equations (74) to (77) must be solved by iteration (e.g., using the secant method). In either case, for a given M_1 and either ε or δ, the corresponding M_{N1}, M_{N2}, M_2, and either ε or δ can be determined.

The remaining flow property ratios are obtained from the corresponding results for a normal shock wave [see Reference (8)].

$$\frac{P_2}{P_1} = \frac{2\gamma}{\gamma-1} M_{N1}^2 - \frac{\gamma-1}{\gamma+1} \tag{78}$$

$$\frac{\rho_2}{\rho_1} = \frac{(\gamma+1)\, M_{N1}^2}{2 + (\gamma-1)M_{N1}^2} \tag{79}$$

$$\frac{V_{N2}}{V_{N1}} = \frac{\rho_1}{\rho_2} \tag{80}$$

$$V_T = V_1 \cos\varepsilon \tag{81}$$

$$V_2 = (V_{N2}^2 + V_T^2)^{1/2} \tag{82}$$

C. NUMERICAL SOLUTION PROCEDURE

Two different oblique shock wave situations occur in a scarfed nozzle. The first situation is at the junction of the basic nozzle and the nozzle extension, point E in Figure 14, where the oblique shock wave emanates. At that point, the flow turning angle δ is specified as the difference between the flow angle at the end of the basic nozzle and the flow angle at the beginning of the nozzle extension. The procedure described in the preceding paragraphs can be applied directly to determine the properties of the oblique shock wave at that point.

The second situation is the general point on the oblique shock wave where both the upstream and downstream flowfield affect the shock wave. Since the strength of an oblique shock wave is greater than the strength of a Mach line, the oblique shock wave emanating from point E propagates into the upstream flowfield at a steeper angle than the angle of the right-running Mach lines emanating from the basic nozzle contour. Since a right-running oblique shock wave turns the flow toward the axial direction (i.e., toward the shock wave) and the Mach number and Mach angle are smaller downstream of an oblique shock wave, the slopes of the right-running Mach lines on the downstream side of the shock wave are greater that the slope of the shock wave. Consequently, the location and stength of the oblique shock wave are also influenced by the downstream flowfield. Thus, the portion of the downstream flowfield that interacts with the oblique shock wave must be determined along with

the determination of the shock wave itself. Figure 16 illustrates the propagation of the oblique shock wave into the upstream flowfield and the overtaking of the shock wave on the downstream side by a Mach line from the nozzle extension.

The region of the flowfield affecting the solution at a point on the oblique shock wave, denoted as point 4, is outlined in Figure 16. The upstream flowfield is assumed to be specified, and the propagation of the oblique shock wave from point E to point 5 has been calculated, as has the right-running Mach line on the downstream side of the shock wave from the nozzle extension to the left-running Mach line from point 5. An enlarged illustration of this region is presented in Figure 17.

The determination of the location of point 4 and the flow properties on either side of the oblique shock wave at that point requires an iterative procedure having five major steps. The first step is to find the location of point 4 as the intersection of the oblique shock propagated from point 5 at the average wave angle $\bar{\varepsilon}$ with the left-running Mach line propagated from point 2 in the known upstream flowfield. This is accomplished in an iterative manner by first assuming a value for ε_4 (note that ε_5 is known), performing the remaining four major steps outlined below, and then varying ε_4 iteratively until the overall procedure converges.

The second step is the application of the method of characteristics for irrotational flow (see Section III.3) to determine the flow properties at point 4 on the upstream side of the oblique shock wave. The third step is the determination of the flow properties at point 4 on the downstream side of the oblique shock wave by applying the oblique shock

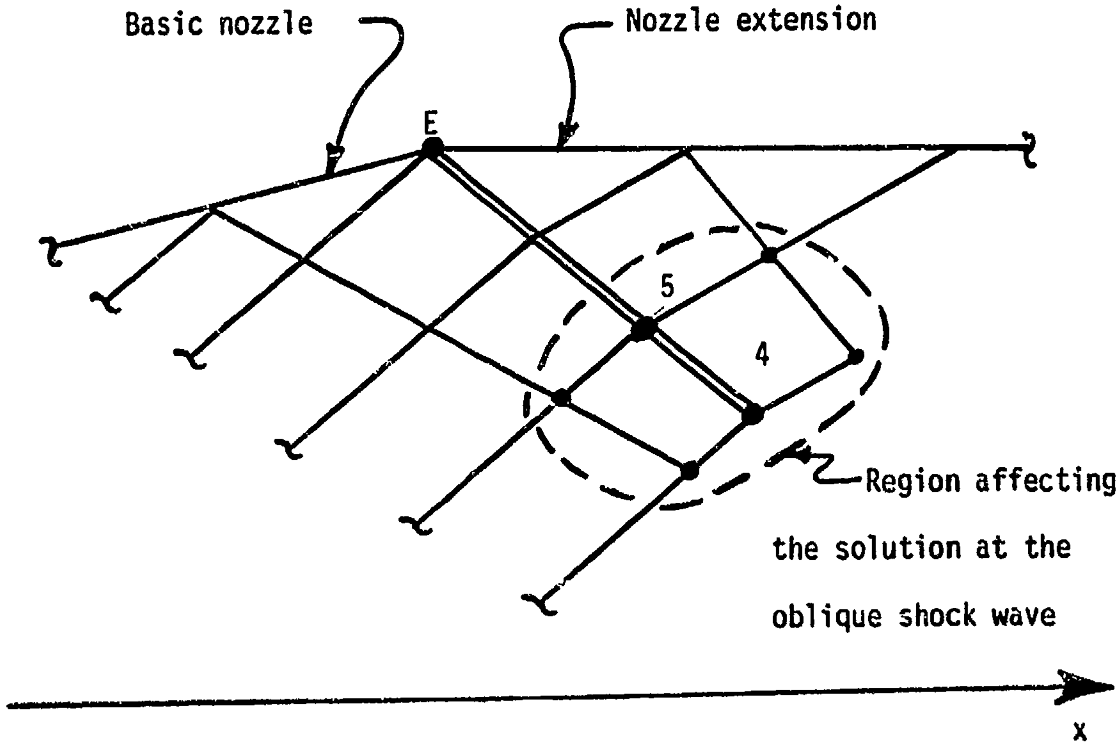
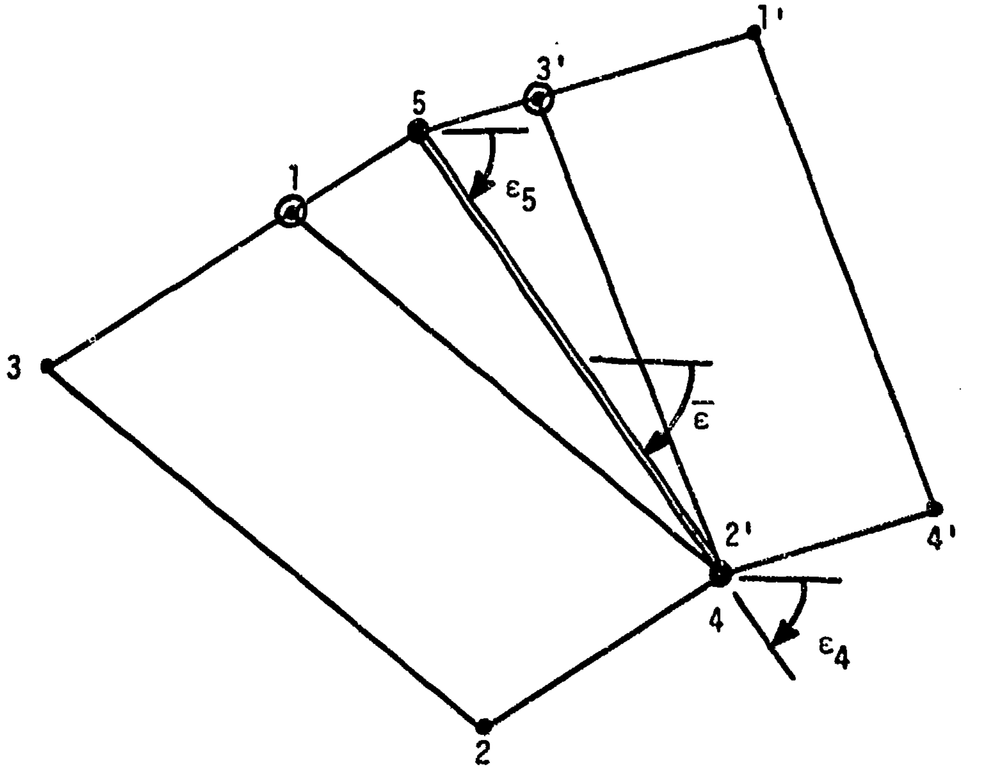


Figure 16. Propagation of the oblique shock wave.



Known points: 1', 2, 3, and 5

Solution points: 4, 2', and 4'

Interpolated points: 1 and 3'

Figure 17. Oblique shock wave point unit process.

wave analysis presented at the beginning of this section. The fourth step is the application of the method of characteristics for rotational flow (see Section III.5) to determine the flow properties at point 4', which is the intersection of the left-running Mach line from point 4 on the downstream side of the oblique shock wave with the right-running Mach line from point 1'.

All of the above four steps are performed for a specified value of ε_4, the oblique shock wave angle at point 4, which together with the known wave angle ε_5 at point 5, defines the average wave angle $\bar{\varepsilon}$ and thus the location of point 4. A check on the correctness of ε_4 is made as the fifth step in the overall procedure. The pressure P_{4d} on the downstream side of the oblique shock wave is computed in step 3 above. A right-running Mach line is projected rearward from point 4 to intersect a previous Mach line (or the wall of the nozzle extension for the first point on the oblique shock wave downstream of point E) at point 3'. The compatibility relation valid along that Mach line is solved to obtain a second value for P_{4d}. The discrepancy between these two values of P_{4d} is a measure of the error in ε_4. The secant method can be used to vary ε_4 to drive the difference between the two values of P_{4d} to within any desired convergence limit.

The procedure described above is repeated at successive points along the oblique shock wave until the shock wave approaches the nozzle axis.

5. ROTATIONAL FLOW MODEL

A. GOVERNING EQUATIONS

The portion of the flowfield downstream of the oblique shock wave emanating from the junction of the basic nozzle and the nozzle extension is a rotational flowfield due to the transverse entropy gradient caused by the curved oblique shock wave. The basic equations governing a rotational isentropic flowfield are presented in Section III.3 [equations (47), (48), (49), and (51)]. Those equations are repeated and renumbered below.

$$\rho u_x + \rho v_y + u\rho_x + v\rho_y + \frac{\delta \rho v}{y} = 0 \tag{83}$$

$$\rho u u_x + \rho v u_y + P_x = 0 \tag{84}$$

$$\rho u v_x + \rho v v_y + P_y = 0 \tag{85}$$

$$u P_x + v P_y - a^2(u\rho_x + v\rho_y) = 0 \tag{86}$$

Due to the presence of an entropy gradient ∇s, the vorticity $\vec{\zeta}$ is not zero, and equation (53) is not valid. Consequently, the simplifications obtained in equations (57) and (58) are not applicable, and the full set of equations presented above, equations (83) to (86), must be solved. Those equations are solved by the numerical method of characteristics (see Section III.3.B).

B. CHARACTERISTIC EQUATIONS

For steady two-dimensional rotational supersonic flow, three

families of characteristic curves exist; the left-running and right-running Mach lines and the streamlines. The slope λ of a characteristic curve is defined as

$$\frac{dy}{dx} = \lambda \tag{87}$$

A fourth-order equation can be found for determining λ. As shown in Reference (9), that equation is

$$(u\lambda - v)^2 \, [(u\lambda - v)^2 - a^2(1 + \lambda^2)] = 0 \tag{88}$$

The fourth-order equation is the product of two second-order equations. Solving either of those two second-order equations gives two of the characteristic slopes, and solving the other second-order equation gives the other two characteristic slopes.

Solving the first second-order term yields

$$(u\lambda_o - v)^2 = 0 \tag{89}$$

$$\lambda_o = \left(\frac{dy}{dx}\right)_o = \frac{v}{u} \tag{90}$$

which defines the streamline. Since λ_o appears two times, the streamline is a repeated characteristic. The subscript $_o$ will be used henceforth to denote the streamline.

Rearranging the second second-order term yields

$$(u^2 - a^2)\lambda^2 - 2uv\lambda + (v^2 - a^2) = 0 \tag{91}$$

Equation (91) is identical to equation (60), which defines the Mach lines. As shown in Section III.3.C, the Mach lines are given by

$$\left(\frac{dy}{dx}\right)_\pm = \lambda_\pm = \tan\,(\theta \pm \alpha) \tag{92}$$

The subscripts ± are used to denote the left-running and right-running Mach lines, respectively.

Consequently, for steady two-dimensional supersonic rotational flow, four characteristic curves are obtained: the streamline repeated twice and the left-running and right-running Mach lines. Figure 18 illustrates these characteristic curves at a point in a flowfield. A streamline and two Mach lines pass through every point in a flowfield, resulting in three infinite families of characteristic curves.

C. COMPATIBILITY RELATIONS

Equations (83) to (86), when combined and written as directional derivatives along the streamlines and Mach lines, yield two ordinary differential equations valid along the streamlines and one ordinary differential equation valid along each Mach line. Thus, four compatibility relations are determined for steady two-dimensional supersonic rotational flow.

As shown in Section III.3.D, the total derivative of any continuous function f(x,y) must satisfy the relation [see equation (65)]

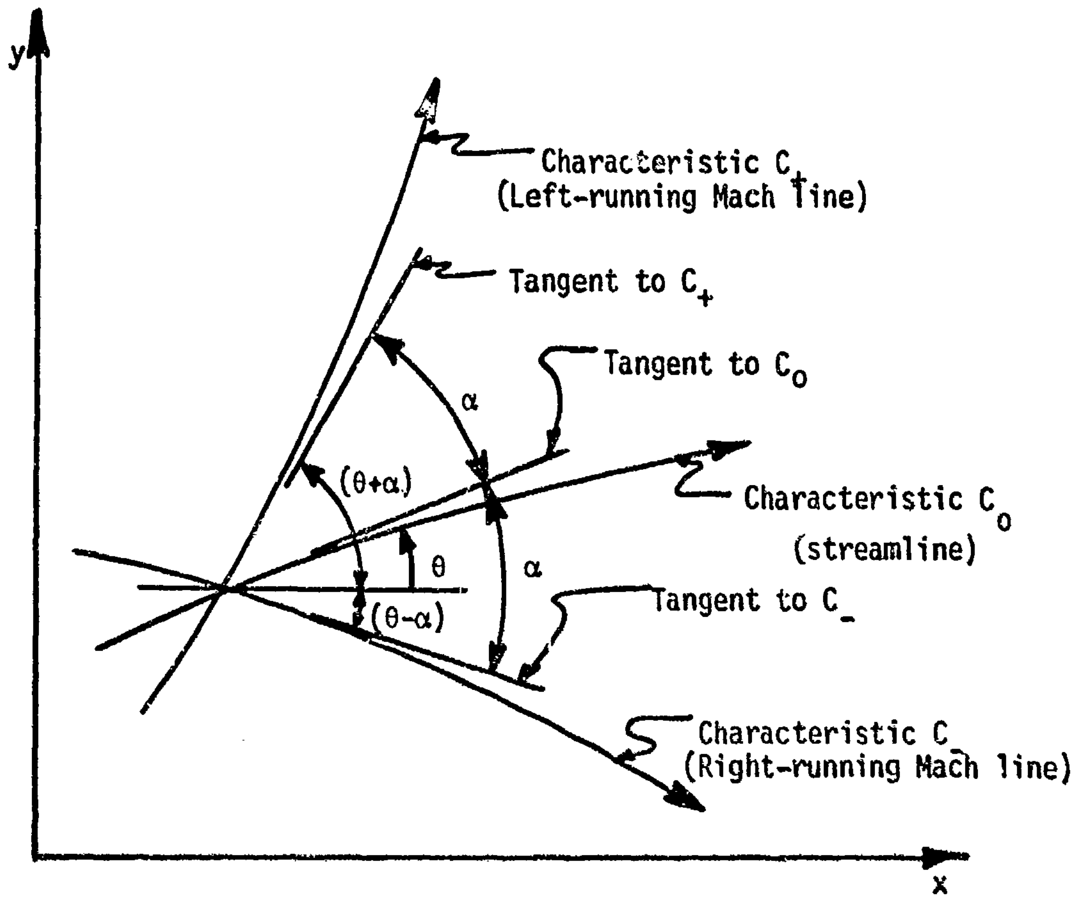


Figure 18. Characteristic curves for rotational flow.

$$\frac{df}{dx} = f_x + \lambda f_y \tag{93}$$

The partial derivatives in equations (83) to (86) can be put in the form of equation (93) by forming appropriate linear combinations of those equations.

First, consider the streamline where λ_0 satisfies equations (89) and (90). Equation (86) may be rearranged as

$$u(P_x + \frac{v}{u} P_y) - ua^2(\rho_x + \frac{v}{u} \rho_y) = 0 \tag{94}$$

The derivatives in equation (94) are in the form of equation (93), where $\lambda = \lambda_0 = v/u$. Consequently, along streamlines, equation (94) may be written as

$$dP - a^2 d\rho = 0 \qquad \text{(on streamlines)} \tag{95}$$

Equation (95) is the speed of sound equation.

The second compatibility relation valid along streamlines can be determined by multiplying equation (85) by λ and adding the result to equation (84).

$$\rho u(u_x + \frac{v}{u} u_y) + \lambda \rho u(v_x + \frac{v}{u} v_y) + (P_x + \lambda P_y) = 0 \tag{96}$$

The derivatives in equation (96) are in the form of equation (93), where $\lambda = \lambda_0 = v/u$. Consequently, noting that along streamlines $\lambda u = v$, equation (96) may be written as

$$\rho u \, du + \rho v \, dv + dP = 0 \tag{97}$$

Equation (97) is Bernoulli's equation for steady two-dimensional isentropic flow, which may be written as

$$\rho V \, dV + dP = 0 \qquad \text{(on streamlines)} \tag{98}$$

Second, consider the Mach lines where $\lambda_{\pm}$ satisfies equations (91) and (92). The compatibility relation valid along Mach lines is obtained by forming the following sum:

$$\begin{aligned}&(u\lambda_{\pm} - v)\,[\text{Eq. (82)}] + (-\lambda_{\pm})\,[\text{Eq. (80)}] + [\text{Eq. (81)}] + \\ &\quad \frac{(u\lambda_{\pm} - v)}{a^2}\,[\text{Eq. (82)}] = 0\end{aligned} \tag{99}$$

After considerable manipulation, equation (99) reduces to

$$\begin{aligned}&(\rho v)du_{\pm} - (\rho u)dv_{\pm} + [\lambda_{\pm} - u(u\lambda_{\pm} - v)/a^2]dP_{\pm} - \\ &\quad \delta[\rho v(u\lambda_{\pm} - v)/y]dx_{\pm} = 0\end{aligned} \tag{100}$$

Equation (100) can be simplified by using the definitions

$$u = V\cos\theta, \; v = V\sin\theta, \; \theta = \tan^{-1}(v/u), \; \alpha = \sin^{-1}(1/M) \tag{101}$$

where θ is the flow angle and α is the Mach angle. After considerable manipulation, the following result is obtained.

$$\frac{\sqrt{M^2-1}}{\rho V^2}\, dP_{\pm} \pm d\theta_{\pm} + \delta\left[\frac{\sin\theta}{yM\cos(\theta\pm\alpha)}\right] dx_{\pm} = 0 \tag{102}$$

where the upper subscripts on dP, dθ, and dx and the upper signs in ± dθ and cos (θ±α) correspond to the left-running Mach line, and vice versa.

D. SUMMARY OF RESULTS

In summary, for steady two-dimensional rotational supersonic flow, three infinite families of characteristic curves exist; the streamlines and the left-running and right-running Mach lines. Along the streamlines,

$$\left(\frac{dy}{dx}\right)_0 = \lambda_0 = \frac{v}{u} \tag{103}$$

$$dP_0 - a^2\, d\rho_0 = 0 \tag{104}$$

$$\rho V\, dV_0 + dP_0 = 0 \tag{105}$$

Along the Mach lines,

$$\left(\frac{dy}{dx}\right)_{\pm} = \lambda_{\pm} = \tan(\theta\pm\alpha) \tag{106}$$

$$\frac{\sqrt{M^2-1}}{\rho V^2}\, dP_{\pm} \pm d\theta + \delta\left[\frac{\sin\theta}{yM\cos(\theta\pm\alpha)}\right] dx_{\pm} = 0 \tag{107}$$

E. NUMERICAL METHOD OF CHARACTERISTICS

The characteristic equations and compatibility relations for steady two-dimensional rotational supersonic flow are presented in the

preceding section. Those equations are ordinary differential equations. They can be integrated numerically by the second-order accurate modified-Euler predictor-corrector method. Such a procedure is called the numerical method of characteristics. The details of its implementation are presented in Reference (9). That is the procedure employed to calculate the flowfield in the nozzle extension downstream of the oblique shock wave emanating from the junction of the basic nozzle and the nozzle extension.

The basic procedure is to start from the downstream side of the oblique shock wave. The left-running and right-running Mach lines are constructed by solving equation (106). The pressure P and flow angle θ are determined at the intersections of the Mach lines by solving equation (107). The streamlines passing through these intersection points are projected upstream to intersect diagonal lines joining upstream intersection points by solving equation (103). The density ρ and velocity V are determined at the intersection points by solving equations (104) and (105). Since equations (103) to (107) are coupled and nonlinear, they must be solved numerically and simultaneously. This procedure defines the interior point unit process.

When a left-running Mach line impinges on the wall of the nozzle extension, the boundary conditions of known wall location and slope must be applied. A right-running Mach line is reflected into the flowfield from that point of impingement. That procedure defines the wall point unit process.

This procedure is continued until the entire flowfield in the nozzle extension has been crisscrossed with left-running and right-

running Mach lines and the flow properties have been calculated at all of the intersections of the two families of Mach lines. A coarse schematic of the resulting flowfield is illustrated in Figure 19.

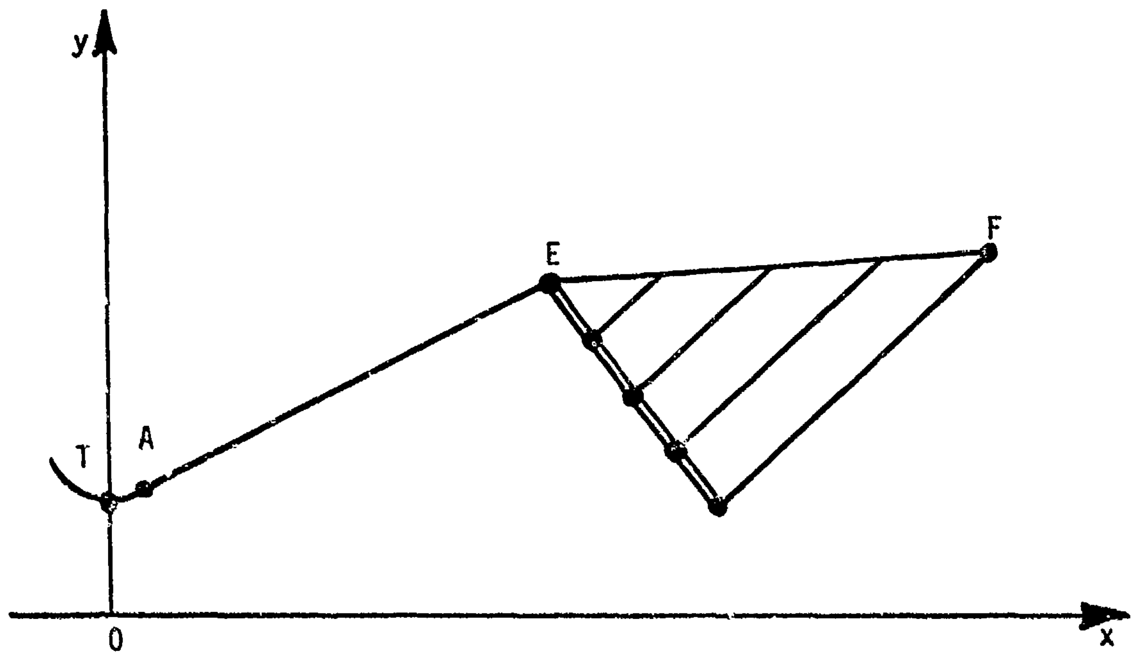


Figure 19. Mach line network in the nozzle extension.

SECTION IV

SCARFED NOZZLE PERFORMANCE MODEL

1. INTRODUCTION

The performance of a propulsive nozzle is specified by its mass flow rate, thrust vector, and moment vector. For conventional nozzles, the thrust vector lies along the nozzle axis, and the only thrust component is the axial component. In that case, all of the moments are zero. For a scarfed nozzle, side forces and moments are present. The present section presents the performance model for the scarfed nozzle configurations considered in this study (see Section III.2).

2. NOZZLE GEOMETRIC MODEL

The nozzle geometric model considered in the present investigation is illustrated schematically in Figure 20. The basic nozzle consists of a double circular arc throat following by a supersonic expansion contour. The supersonic expansion contour may be conical, quadratic, or specified by tabular data. The basic nozzle geometry and flowfield are axisymmetric.

The nozzle extension is a conical contour attached to the basic nozzle. The flow in the nozzle extension is assumed to be axisymmetric. That is, the wave (i.e., Mach line or shock wave) emanating from point E is assumed to fall downstream of the exit of the scarfed conical extension, as illustrated in Figure 20. In that case, the flowfield in the scarfed nozzle extension may be computed as though the nozzle extension were not scarfed (i.e., as if the dashed protion of the contour were present). The flowfield downstream of line EG, which is outside of the solid nozzle boundary, is obviously three-dimensional. However, the flowfield upstream of line EF is axisymmetric.

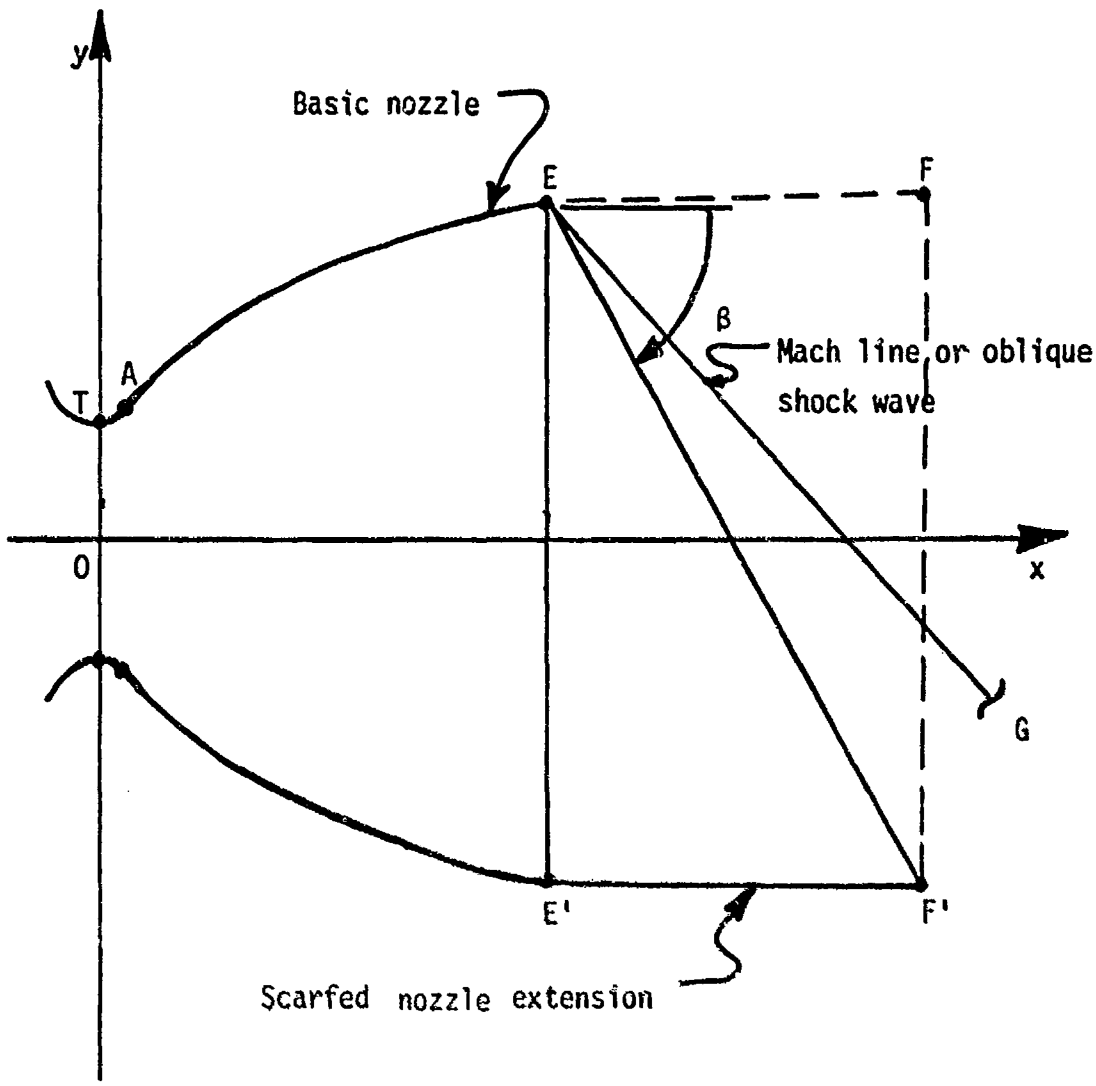


Figure 20. Scarfed nozzle geometric model.

3. BASIC NOZZLE PERFORMANCE EVALUATION

The basic nozzle is a conventional axisymmetric nozzle. The flowfield in the throat region is predicted by the linearized flow analysis presented in Section III.2. From that analysis, an initial-value line is obtained from which the supersonic flowfield can be calculated. In addition, (see Figure 10), the nozzle mass flow rate $\dot{m}$, discharge coefficient C_D, and initial-value line thrust F_{IVL} are obtained.

The flowfield in the supersonic region is calculated by the method of characteristics for steady two-dimensional irrotational supersonic flow, as discussed in Section III.3. A schematic of the resulting Mach line network is presented in Figure 12. From that analysis, the pressure acting along the wall is known at each point where a Mach line intersects the wall. The thrust developed along the supersonic expansion contour is obtained by integrating (numerically) the axial component of the force developed by the pressure acting on the wall. Thus,

$$F_{SS} = \int_{y_t}^{y_e} (P - P_a)\, 2\pi y\, dy \tag{108}$$

The total thrust developed by the basic nozzle, F_N, is the sum of the thrust developed across the initial-value line, F_{IVL}, and the thrust developed along the supersonic contour, F_{SS}. Thus,

$$F_N = F_{IVL} + F_{SS} \tag{109}$$

4. SCARFED NOZZLE EXTENSION PERFORMANCE EVALUATION

The flowfield in the nozzle extension is calculated by the method of characteristics for steady two-dimensional rotational supersonic flow, as discussed in Section III.4. A schematic of the resulting Mach line network is presented in Figure 19. From that analysis, the pressure acting along the wall of the nozzle extension is known at each point where a Mach line intersects the wall. The thrust and moments developed by the scarfed nozzle extension are obtained by integrating (numerically) the differential force and moment components developed by the pressure acting on the wall.

In the present analysis, it is assumed that the nozzle extension is axisymmetric (in fact, conical) and that the exit of the nozzle extension is scarfed by a plane perpendicular to the xy plane which passes through point E on the top of the nozzle where scarfing begins and through point F on the bottom of the nozzle where scarfing ends. Consequently, the flowfield is symmetrical about the xy plane. Thus, as illustrated in Figure 21, only two force components exist, F_x and F_y, and only one moment component exists, M_z. The force components and moment are assumed to act at the center of the throat of the nozzle.

The geometric model employed to determine the force components and moment developed by the scarfed nozzle extension is illustrated in Figure 22. The geometry of the scarfed nozzle extension is specified by the location of point E (x_e, y_e), the angle of the scarfed conical extension θ_f, and either the scarfing angle β or the location of point F (x_f, y_f).

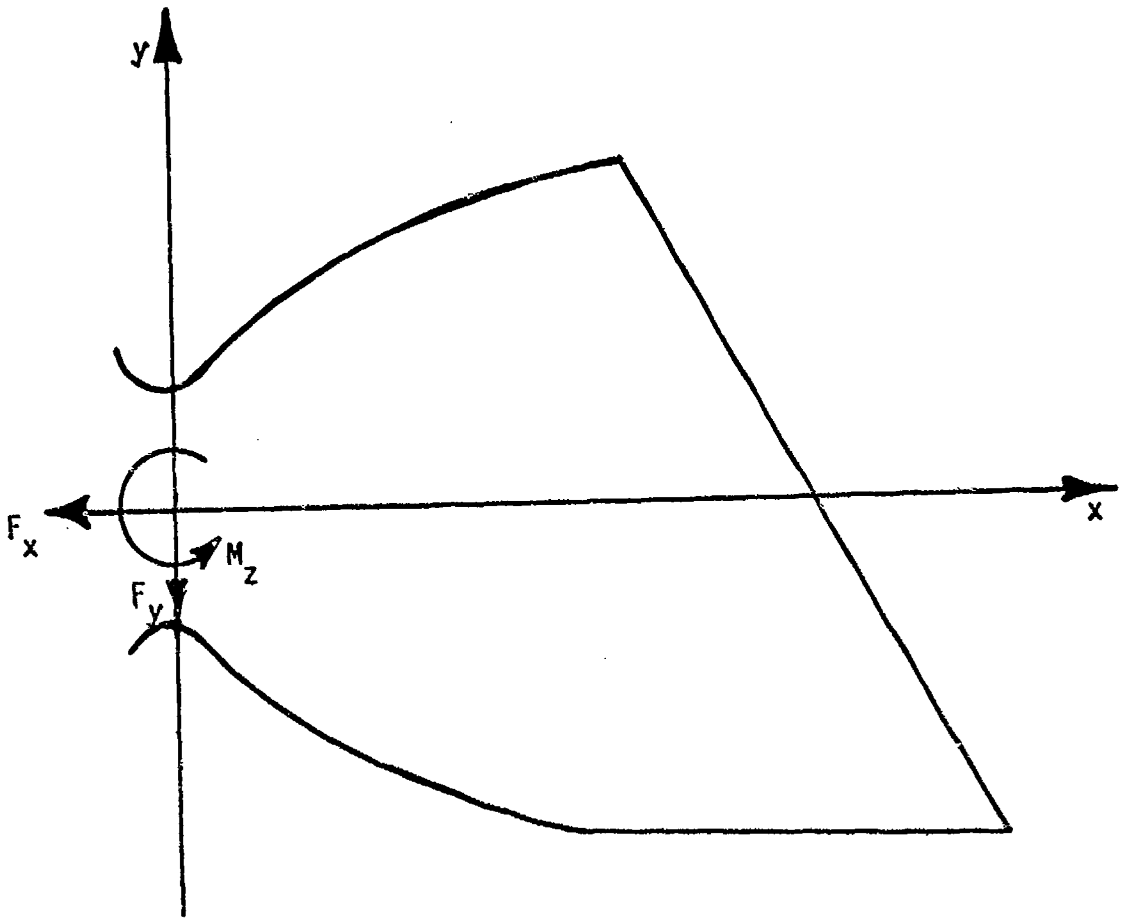
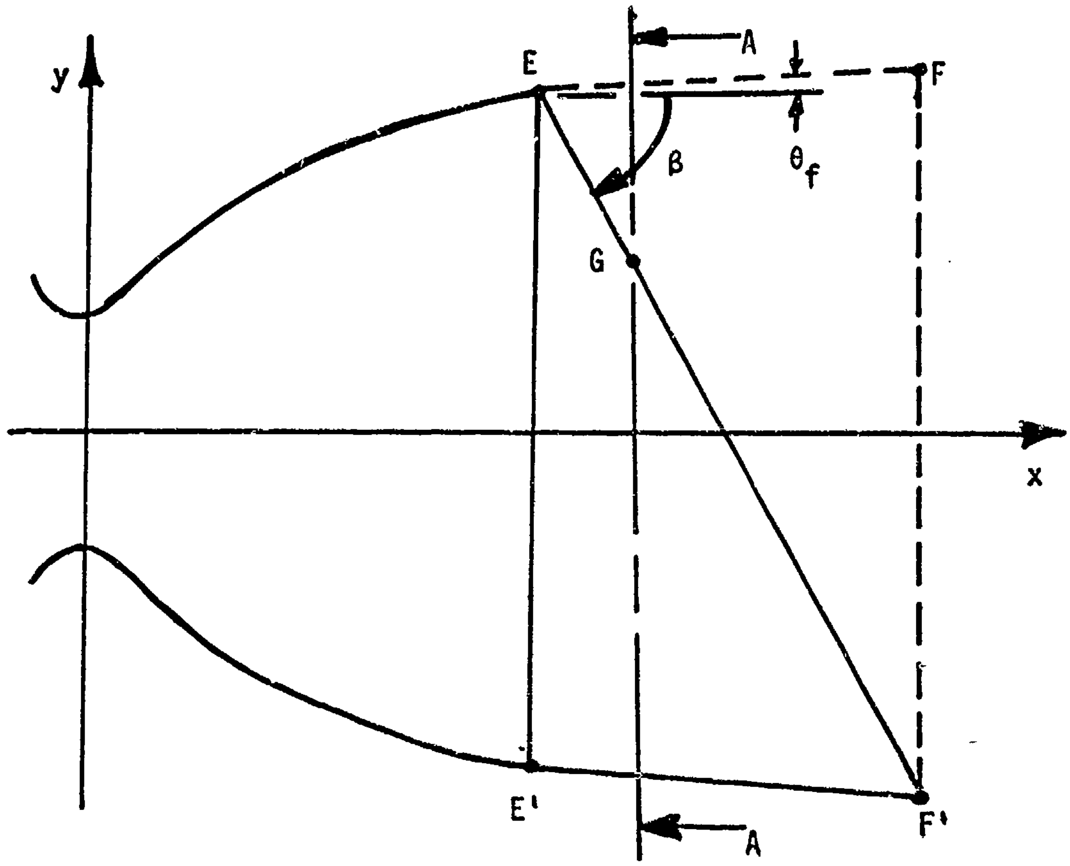
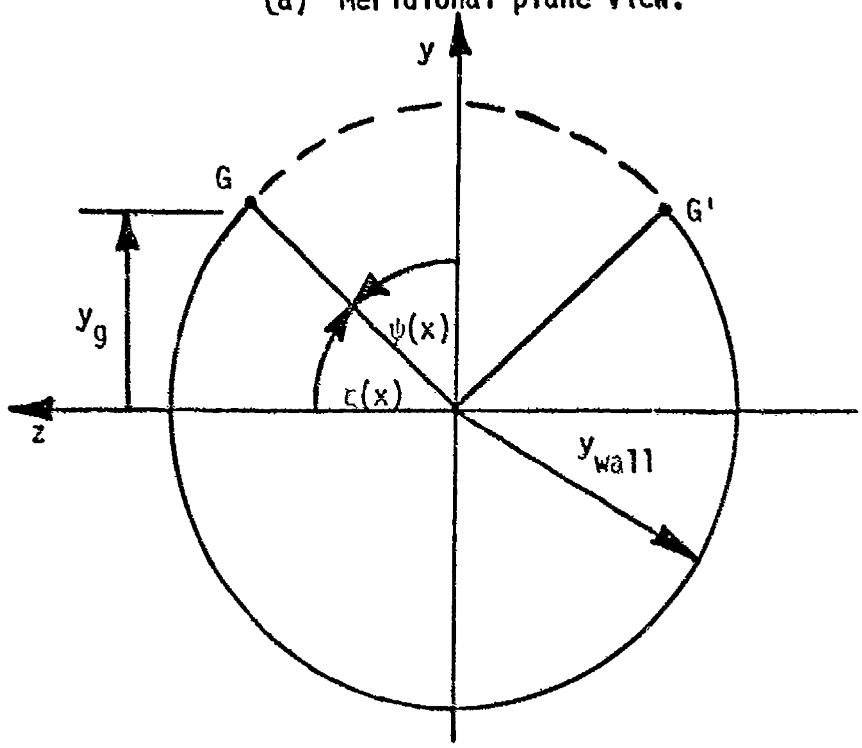


Figure 21. Scarfed nozzle performance model.



(a) Meridional plane view.



(b) Cross section A-A view.

Figure 22. Geometric model for force and moment evaluation.

The locations of points F and F are determined as follows. The equation of the scarfing line, line EF' is given by

$$\frac{y - y_e}{x - x_e} = -\tan \beta \tag{110}$$

where the angle β is in the range $0 \leq \beta \leq 90$ deg. Solving equation (110) for y gives

$$y = y_e + x_e \tan \beta - x \tan \beta = a - x \tan \beta \tag{111}$$

where

$$a = y_e + x_e \tan \beta \tag{112}$$

The equation of line E'F' is given by

$$\frac{y - y_{e'}}{x - x_{e'}} = -\tan \theta_f \tag{113}$$

$$y = y_{e'} + x_{e'} \tan \theta_f - x\tan \theta_f = b - x\tan \theta_f \tag{114}$$

where

$$b = y_{e'} + x_{e'} \tan \theta_f \tag{115}$$

Substituting (x_f, y_f) into equations (111) and (113) gives

$$y_{f'} = a - x_f \tan\beta \tag{116}$$

$$y_{f'} = b - x_f \tan\theta_f \tag{117}$$

Solving equations (116) and (117) simultaneously yields

$$x_f = \frac{a - b}{\tan\beta - \tan\theta_f} \tag{118}$$

Equation (117) may then be solved for y_f and $y_f = -y_{f'}$.

Point G illustrated in Figure 22 is the intersection point of a plane perpendicular to the nozzle axis with the edge of the scarfed extension, line EF. The location of point G corresponding to a specified value of x_g is obtained by substituting x_g into equation (111). Thus,

$$y_g = a - x_g \tan\beta \tag{119}$$

The angle $\zeta(x)$ illustrated in Figure 22 (b) is determined as follows.

$$\zeta(x) = \sin^{-1}(y_g/y_{wall}) \tag{120}$$

where y_{wall} is the radius of the scarfed conical extension at point G. The angle $\psi(x)$ illustrated in Figure 22(b) is determined from

$$\psi(x) = \frac{\pi}{2} - \zeta(x) \tag{121}$$

All of the geometric properties of the scarfed conical extension are now determined. Those properties are the coordinates (x_e, y_e) and (x_f, y_f), the equation of the scarfing line EF' [equation (114)], and the angle $\psi(x)$.

The performance of the scarfed conical extension is determined by integrating the pressure forces acting along the wall from the point where the scafing begins, point E, to the end of the scarfed conical extension, point F. The geometric model for integrating the pressure forces is presented in Figure 23. The scarfed conical extension is assumed to be symmetrical about the xy plane. Consequently, the pressure forces acting on only one-half of the nozzle must be determined by integration. The total pressure force is then found by symmetry. For symmetry about the xy plane, no net component of the pressure force acts in the z-direction.

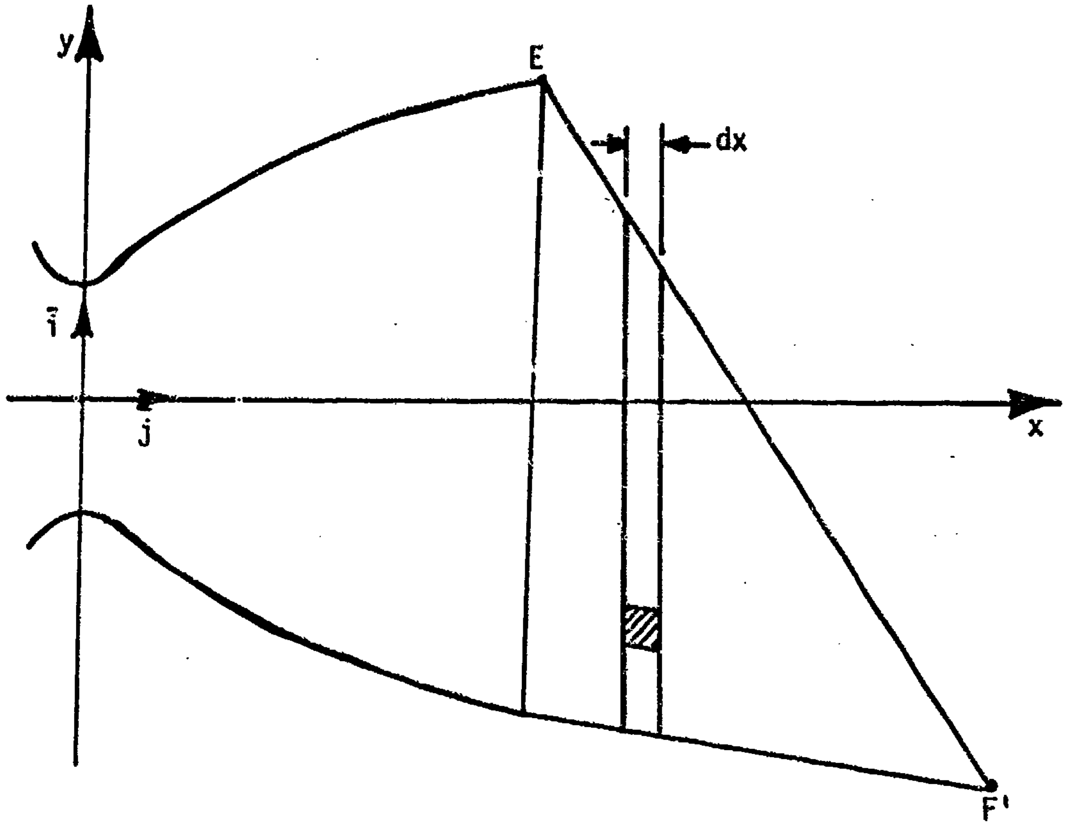
The components of the pressure force acting in the x and y directions are determined by defining a differential element of area $d\overline{A}$ having a magnitude dA and acting in the direction of the outward unit normal $\overline{n}$. The unit vector system $\overline{i}$, $\overline{j}$, $\overline{k}$ in the Cartesian coordinate system xyz is illustrated in Figure 23. The radial unit vector $\overline{i}_r$, which is directed radially outward from the x-axis and lies in a plane perpendicular to the x-axis, is also illustrated in Figure 23. The element of area $d\overline{A}$ is given by

$$d\overline{A} = \overline{i}_r \, dA_r - \overline{i} \, dA_x \tag{122}$$

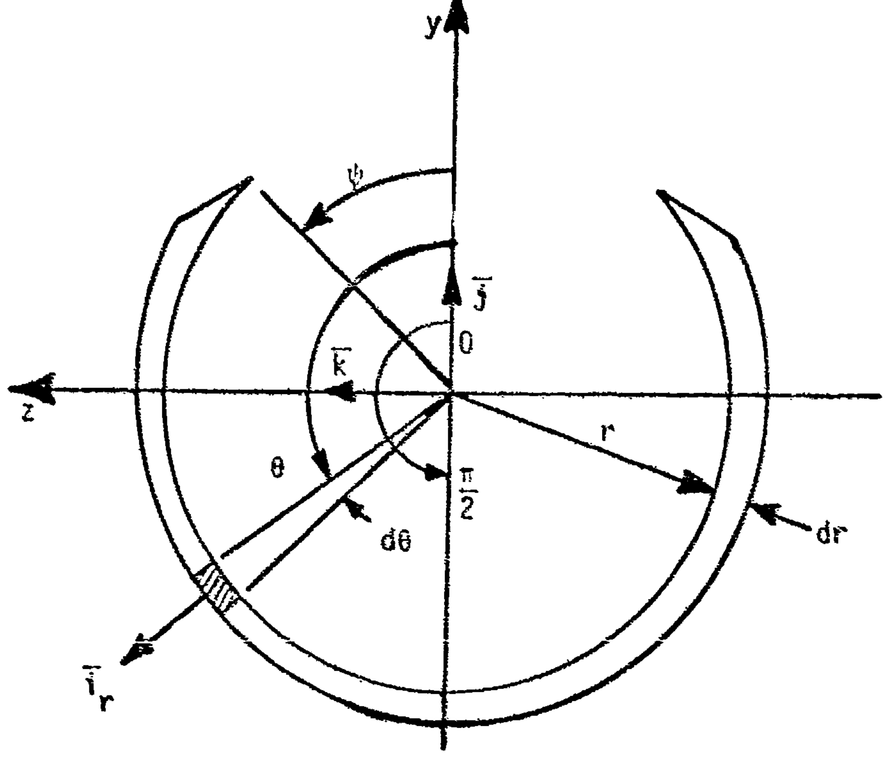
where

$$dA_r = r \, d\theta \, dx \tag{123}$$

$$dA_x = r \, d\theta \, dr \tag{124}$$



(a) Meridional plane view.



(b) Cross-section view.

Figure 23. Geometric model for thrust calculations.

In the Cartesian coordinate system, $\bar{i}_r$ is given by

$$\bar{i}_r = \bar{j} \cos \theta + \bar{k} \sin \theta \tag{125}$$

where θ is measured counterclockwise from the positive y-axis. Combining equations (122) to (125) gives

$$d\bar{A} = -\bar{i}\ r\ d\theta\ dr + \bar{j}\ r \cos \theta\ d\theta\ dx + \bar{k}\ r \sin \theta\ d\theta\ dx \tag{126}$$

The pressure force is given by

$$d\bar{F}_p = (P - P_a)\ d\bar{A} \tag{127}$$

Due to the symmetry about the xy plane, the net component of the pressure force perpendicular to that plane is zero. Consequently, the third term on the right-hand side of equation (126) may be dropped from consideration, and equations (126) and (127) may be combined to yield

$$d\bar{F}_p = -\bar{i}(P - P_a) r\ d\theta\ dr + \bar{j}(P - P_a) r \cos \theta\ d\theta\ dx \tag{128}$$

The total pressure force acting on the scarfed conical extension is obtained by integrating equation (128) between plane EE' and plane FF'. Thus,

$$\bar{F}_p = \bar{i}\ F_x + \bar{j}\ F_y \tag{129}$$

where

$$F_x = -\int_{y_e}^{y_f}\int_{\theta_e}^{\theta_f}(P - P_a)r\, d\theta\, dr \tag{130}$$

$$F_y = \int_{x_e}^{x_f}\int_{\theta_e}^{\theta_f}(P - P_a)r \cos\theta\, d\theta\, dx \tag{131}$$

The pressure P acting on the nozzle wall is a function of the local value of x, but it is not a function of the angle θ at a given axial location. Consequently, at a given axial location, equations (130) and (131) may be integrated over the range $\psi \leq \theta \leq \pi$, where ψ is a function of the axial location. Thus,

$$F_x = -2\int_{y_e}^{y_f}(\pi-\psi)(P - P_a)r\, dr \tag{132}$$

$$F_y = -2\int_{x_e}^{x_f}(P - P_a)r \sin\psi\, dx \tag{133}$$

The factor 2 appearing in equations (132) and (133) accounts for the two halves of the nozzle, since θ is integrated from ψ to π.

In equations (132) and (133), the pressure P is a function of the axial location. Consequently, those two equations must be integrated numerically. At any given axial location, the integral of equation (132) over the radial increment y_{i-1} to y_i and the integral of equation (133) over the axial increment x_{i-1} to x_i are given by

$$(\Delta F_x)_i = -2\overline{P}\,\overline{y}\,(\pi - \overline{\psi})\,(y_i - y_{i-1}) \tag{134}$$

$$(\Delta F_y)_i = -2\overline{P}\,\overline{y} \sin \overline{\psi}\,(x_i - x_{i-1}) \tag{135}$$

where the overbar denotes average values over the increment i-1 to i, defined as

$$\overline{P} = 0.5(P_i + P_{i-1}) - P_a \tag{136}$$

$$\overline{y} = 0.5(y_i + y_{i-1}) \tag{137}$$

$$\overline{\psi} = 0.5(\psi_i + \psi_{i-1}) \tag{138}$$

The negative signs in equations (134) and (135) indicate that F_x and F_y act in the negative directions relative to the coordinate system illustrated in Figure 23.

The total pressure force acting on the scarfed conical extension, F_{SCE}, is obtained by summing equations (134) and (135) over the range x_e to x_f. Thus,

$$F_{x,\ SCE} = \sum_{i=2}^{N} (\Delta F_x)_i \tag{139}$$

$$F_{y,\ SCE} = \sum_{i=2}^{N} (\Delta F_y)_i \tag{140}$$

where i = 1 denotes point E, i = 2 denotes the first wall point downstream of point E, and i = N denotes point F'.

5. SCARFED NOZZLE PERFORMANCE EVALUATION

The total axial force acting on the entire nozzle is obtained by adding the force given by equation (139) to the axial force F_N [see equation (109)] developed by the portion of the nozzle upstream of the conical scarfed extension. Thus,

$$F_x = F_{IVL} + F_{SS} + F_{x,\,SCE} \tag{141}$$

The total side force acting on the entire nozzle is simply the side force acting on the scarfed conical extension, given by equation (140). Thus,

$$F_y = F_{y,\,SCE} \tag{142}$$

The scarfed nozzle axial and side specific impulses are given by

$$(I_{sp})_x = \frac{|F_x|}{\dot{m}} \tag{143}$$

$$(I_{sp})_y = \frac{|F_y|}{\dot{m}} \tag{144}$$

The geometric relationship between the nozzle axis and the missile axis is illustrated in Figure 24. The missile coordinate system is denoted by X,Y. The nozzle coordinate system x,y is assumed to lie in the meridional plane through the missile axis, that is, in the XY plane. The forces acting on the missile are thus

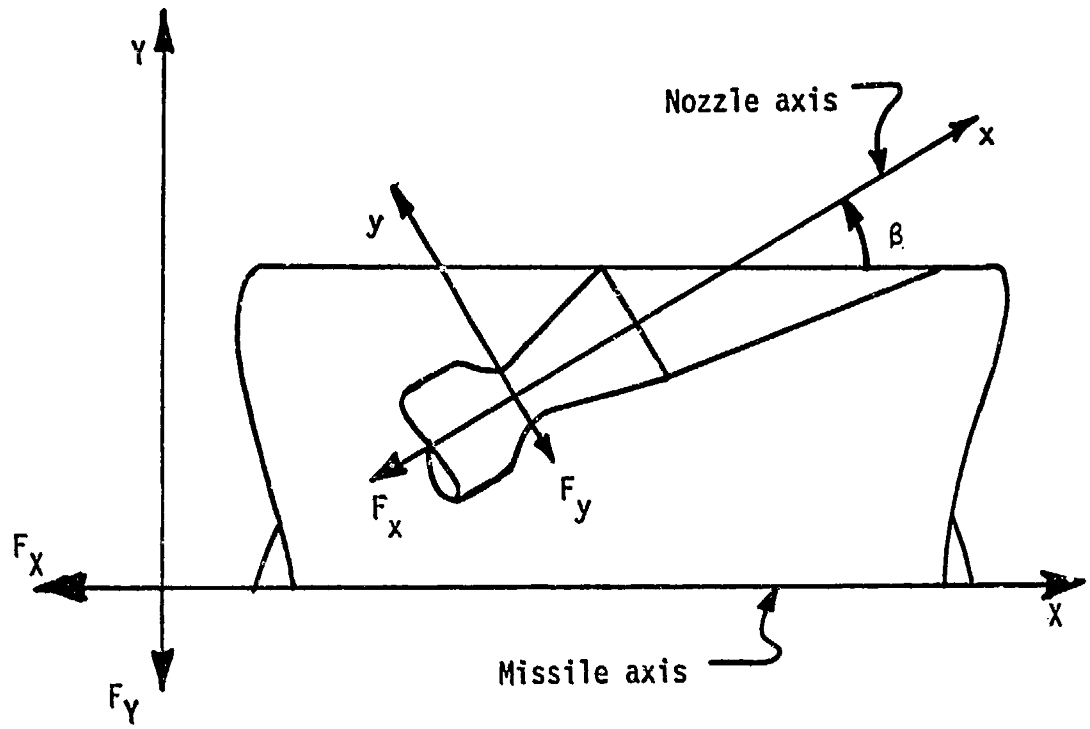


Figure 24. Relationship between nozzle axis and missile axis.

$$F_X = F_x \cos \beta - F_y \sin \beta \tag{145}$$

$$F_Y = F_x \sin \beta + F_y \cos \beta \tag{146}$$

The missile specific impulse is given by

$$(I_{sp})_X = \frac{|F_X|}{\dot{m}} \tag{147}$$

$$(I_{sp})_Y = \frac{|F_Y|}{\dot{m}} \tag{148}$$

In the present analysis, the major item of interest is the axial thrust delivered by the rocket motor to the missile, F_X, and how that thrust is related to the axial thrust developed by the nozzle, F_X. It is assumed that several rocket motors (at least two) are arranged symmetrically around the circumference of the missile, so that all side forces and turning moments exactly cancel. If that is not the case, the analysis may be easily extended to determine the turning moments associated with the scarfed nozzle. That is not done, however, in the present analysis.

The final performance parameter of interest is the ratio η of the axial thrust delivered to the missile, F_X, to the axial thrust that would be generated by the nozzle if the scarfed conical extension were not scarfed and if it were aligned along the axis of the missile. That value of thrust is determined by calculating the axial force developed by the conical extension without scarfing, F_{CE}, and adding that value to the axial force acting on the basic nozzle. The axial force F_{CE} is

determined by applying equation (108) from point E to point F. Thus,

$$F_{CE} = \int_{ye}^{y_f} (P - P_a)\ 2\pi y\ dy \tag{149}$$

Note that if the angle θ_f of the scarfed conical extension is zero, then F_{CE} is zero. The total reference axial thrust of the unscarfed scarfed nozzle F_{Ref} is given by

$$F_{Ref} = F_{IVL} + F_{SS} + F_{CE} \tag{150}$$

Thus, the ratio η is given by

$$\eta = \frac{F_x}{F_{Ref}} \tag{151}$$

The factor η may be regarded as the efficiency of the scarfed nozzle.

From Figure 24, it is obvious that the scarfed nozzle exit flow area lies on the missile skin. Thus, the pressure forces acting on that area are normal to the missile axis and do not contribute to the missile axial thrust. The missile axial thrust depends on the momentum flux crossing the nozzle exit area, which depends on the nozzle mass flow rate and nozzle exit velocity. The exit velocity is independent of the pressure level; it depends on the nozzle geometry, the gas thermodynamic model (i.e., γ and R), and the stagnation temperature T_t. The mass flow rate depends linearly on the pressure level, that is, the stagnation pressure. Consequently, the missile axial thrust and nozzle mass flow rate both depend linearly on the stagnation pressure. However, the

ratio of those two quantities, the missile axial specific impulse, is independent of both the stagnation pressure and the atmospheric pressure. Consequently, missile axial specific impulse is the most meaningful performance parameter for a scarfed propulsive nozzle.

SECTION V

OVERALL NUMERICAL ALGORITHM

1. INTRODUCTION

The objective of the present investigation was to develop a procedure for predicting the performance of a particular class of scarfed propulsive nozzles. That class of nozzles consists of a conventional basic nozzle which has a double circular arc throat contour followed by a conical, quadratic, or tabular supersonic contour. At the end of the basic nozzle, a scarfed conical extension is attached. Figure 25 illustrates this type of scarfed propulsive nozzle. A detailed discussion of the nozzle geometric model is presented in Section II.

The flowfield in the transonic throat region of the nozzle is predicted by a linearized flow analysis. The flowfield in the supersonic portion of the basic nozzle is predicted by the method of characteristics for steady two-dimensional irrotational supersonic flow. The transition between the basic nozzle flowfield and the nozzle extension flowfield occurs across an oblique shock wave that emanates from the junction of the basic nozzle wall and the nozzle extension. The flowfield in the nozzle extension is predicted by the method of characteristics for steady two-dimensional rotational supersonic flow. A detailed discussion of the aforementioned flow models is presented in Section III.

The performance of the scarfed propulsive nozzle is obtained by integrating the flowfield properties to determine the overall

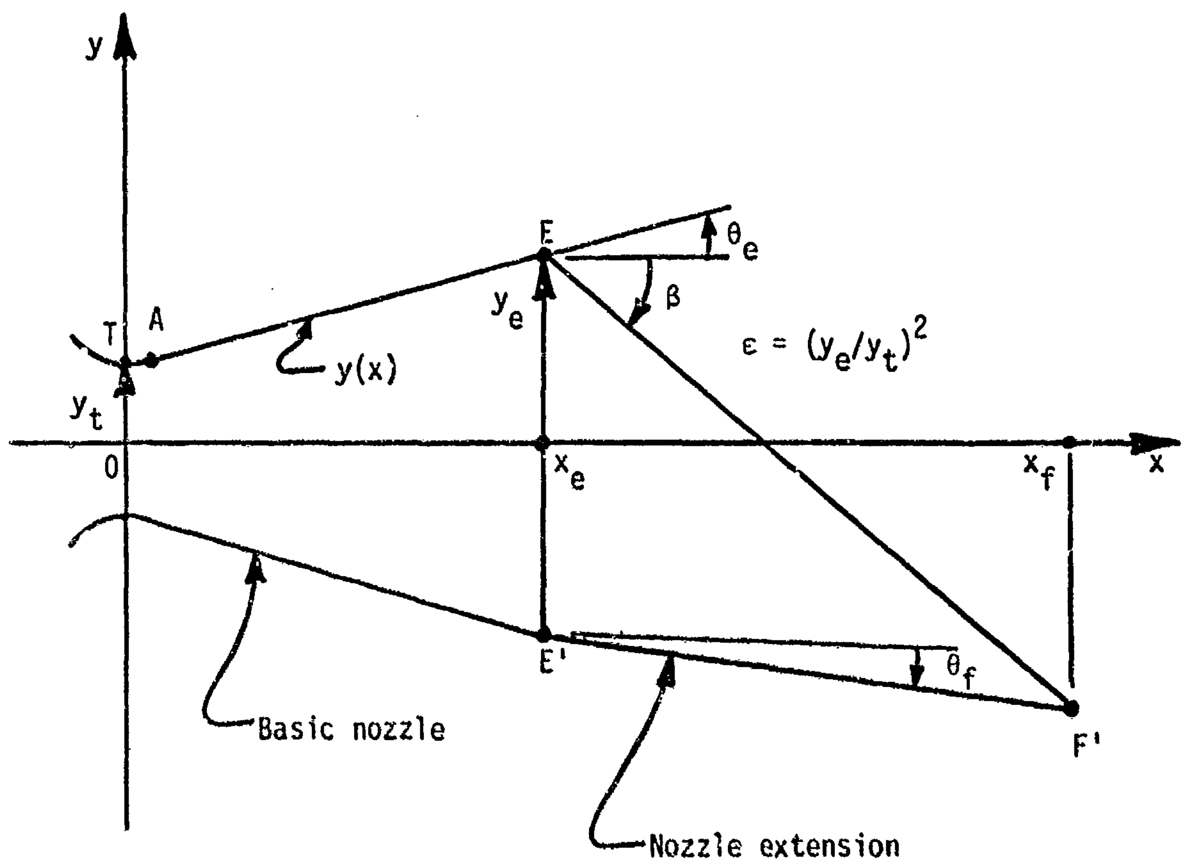


Figure 25. Scarfed nozzle geometric model.

performance parameters (i.e., mass flow rate, force components, and turning moments). The mass flow rate is obtained by integrating across the transonic initial-value line. The thrust of the basic nozzle is determined by integrating the momentum flux and pressure forces across the initial-value line, and adding to that value the integral of the pressure forces along the nozzle wall. The thrust of the nozzle extension is obtained by integrating the pressure forces along the wall of the nozzle extension. The total nozzle thrust components are determined by adding the thrust components of the basic nozzle and the nozzle extension. The thrust delivered to the missile is found by calculating the component of the nozzle thrust components in the direction of the missile axis. Details of the performance model are discussed in Section IV.

The objective of the present section is to present the logic employed to combine all of the individual analyses presented in Sections II to IV into an overall numerical algorithm for predicting the performance of scarfed propulsive nozzles.

A computer program has been written for implementing the analysis developed in this investigation. A discussion of that program is presented in Section VI. In the present section describing the overall numerical algorithm, references are made to the particular program routines that implement the various aspects of the overall numerical algorithm. Thus, program MAIN00 controls the overall logic flow by calling, in sequence, program MAIN10 to read in the input data,

program MAIN20 to construct the flowfield in the basic nozzle, program MAIN30 to construct the flowfield in the nozzle extension, and program MAIN40 to calculate the performance of the scarfed nozzle.

2. FLOWFIELD CONSTRUCTION LOGIC

Five modes of flowfield Mach line network construction are considered in the program. The first four modes all use the right-running Mach line initial expansion flowfield illustrated in Figure 26. The fifth mode uses the left-running Mach line initial expansion flowfield illustrated in Figure 27. In both figures, line TT' is a supersonic initial-value line obtained from a transonic flow analysis. Right-running Mach lines are initiated from each point on line TT', starting adjacent to the nozzle axis, and propagated downward until they intersect the nozzle axis. Right-running Mach line TT', emanating from the nozzle throat point, point T, defines the downstream extent of the flowfield from the initial-value line. This flowfield is identical in Figures 26 and 27.

The initial expansion flowfield illustrated in Figure 26 is obtained by initiating right-running Mach lines from prespecified points along the nozzle throat downstream circular arc contour, contour TA. These right-running Mach lines are continued until they intersect the nozzle axis. Right-running Mach line AA' emanating from the throat attachment point, point A, defines the downstream extent of the flowfield from the initial expansion contour.

The initial expansion flowfield illustrated in Figure 27 is obtained by initiating left-running Mach lines from right-running Mach line TT''. These left-running Mach lines are continued until they intersect the nozzle throat downstream circular arc contour, contour TA. Left-running Mach line A'A emanating from point A' on right-running Mach line TT''

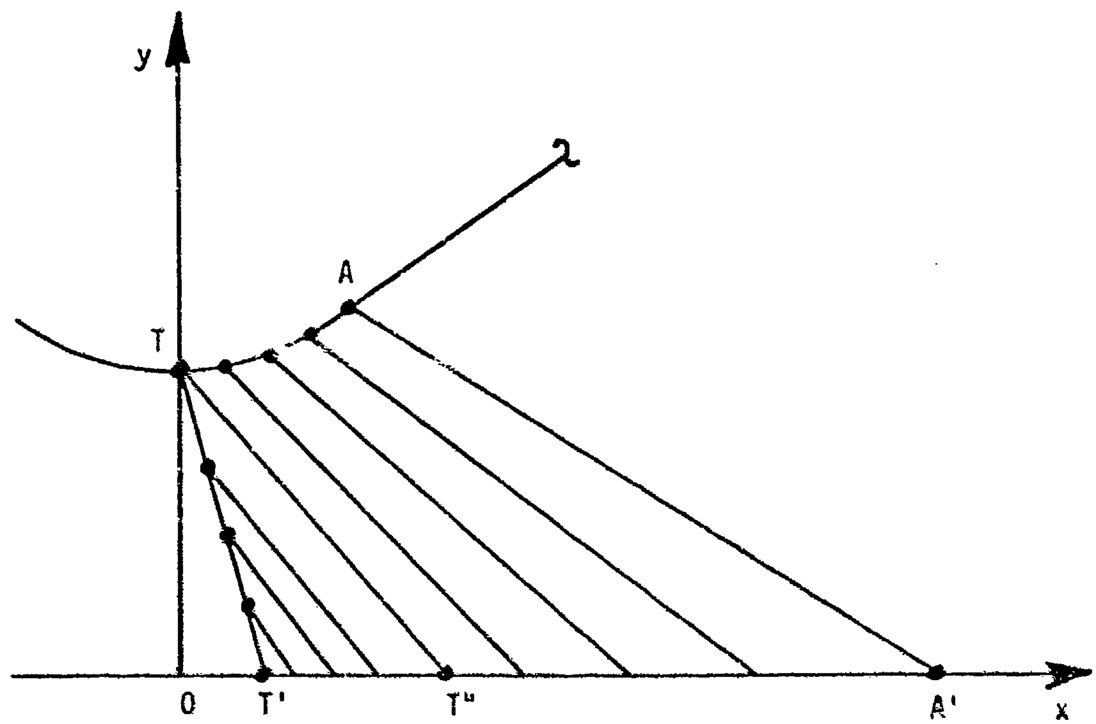


Figure 26. Right-running Mach line initial-expansion flowfield.

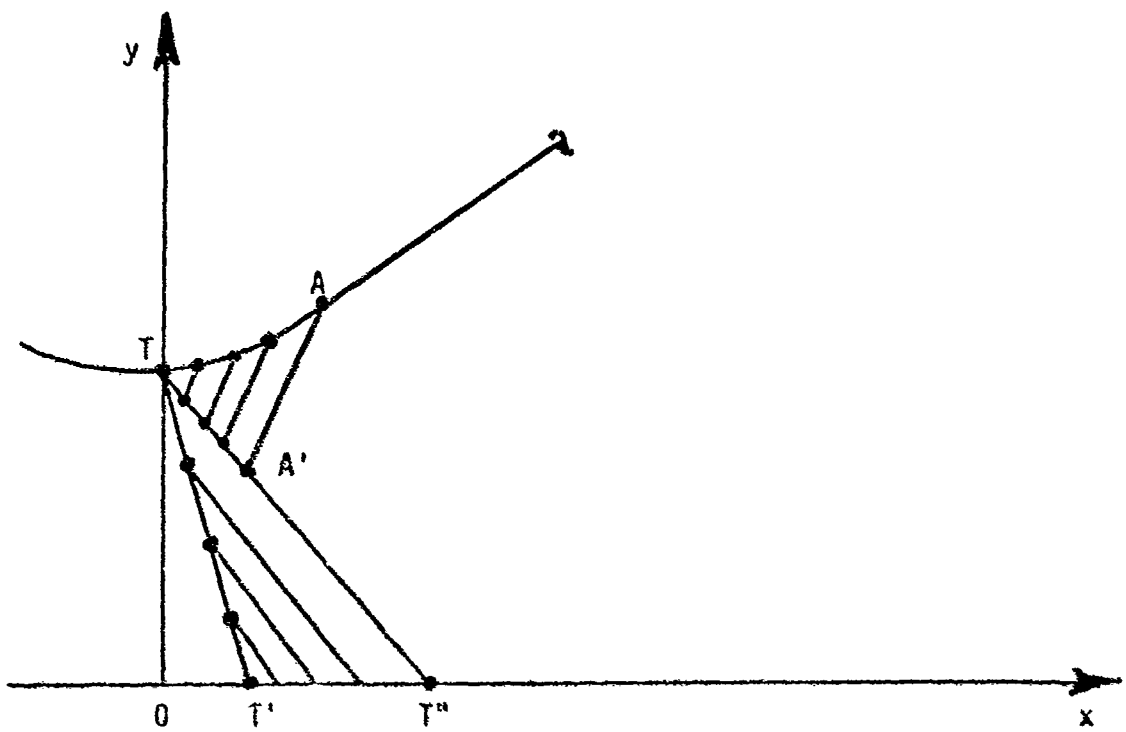


Figure 27. Left-running Mach line initial-expansion flowfield.

and passing through the throat attachment point, point A, defines the downstream extent of the flowfield along the initial expansion contour.

Five different modes of flowfield construction are considered in the program. Those modes of operation are described in the following paragraphs.

Mode 1. The first mode analyzes the flowfield in a nozzle without an extension by constructing a network of right-running Mach lines, as illustrated in Figure 28. The initial expansion flowfield illustrated in Figure 26 is first constructed. Right-running Mach lines are then initiated from points along the nozzle supersonic contour, contour AE. These right-running Mach lines are continued until they intersect the nozzle axis. Right-running Mach line EE', emanating from the nozzle exit lip point, point E, defines the downstream extent of the nozzle flowfield.

Mode 2. This mode analyzes the flowfield in a nozzle without an extension by constructing a network of left-running Mach lines, as illustrated in Figure 29. The initial expansion flowfield illustrated in Figure 26 is first constructed. Left-running Mach lines are then originated from line AA'. These left-running Mach lines are continued until they intersect the nozzle wall, contour AE. Left-running Mach line EE', which passes through the nozzle exit lip point, point E, defines the downstream extent of the nozzle flowfield.

Mode 3. This mode analyzes the flowfield in a nozzle without an extension in which an embedded right-running oblique shock wave is detected and tracked. The flowfield is constructed along a network of left-running Mach lines, as illustrated in Figure 30. The initial

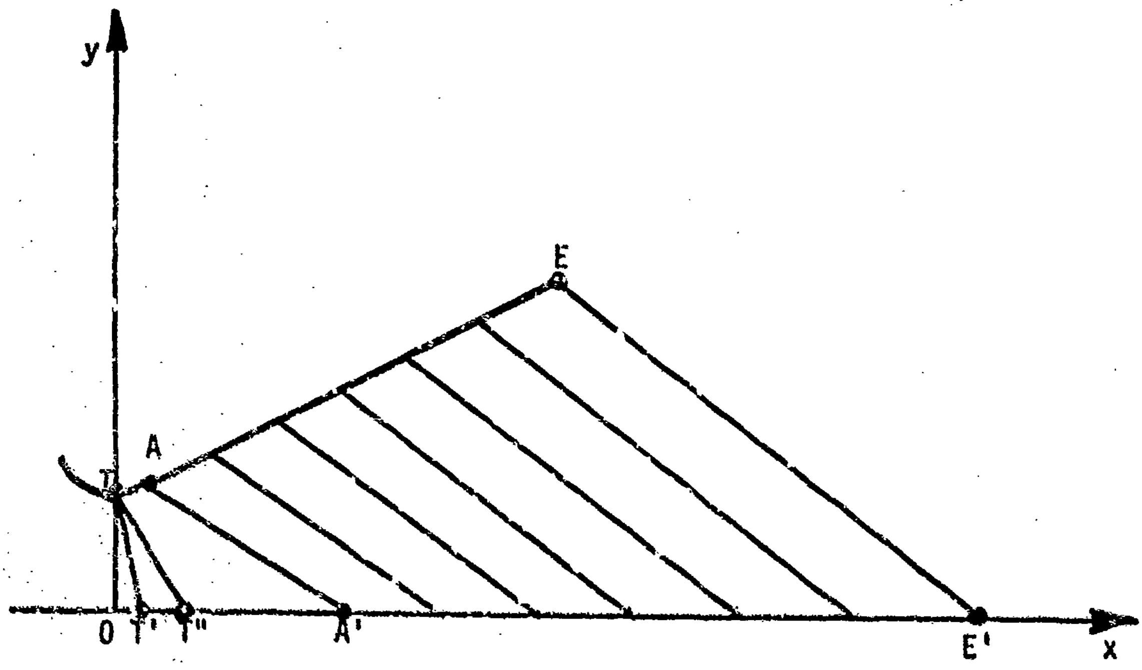


Figure 28. Mode 1 Mach line network.

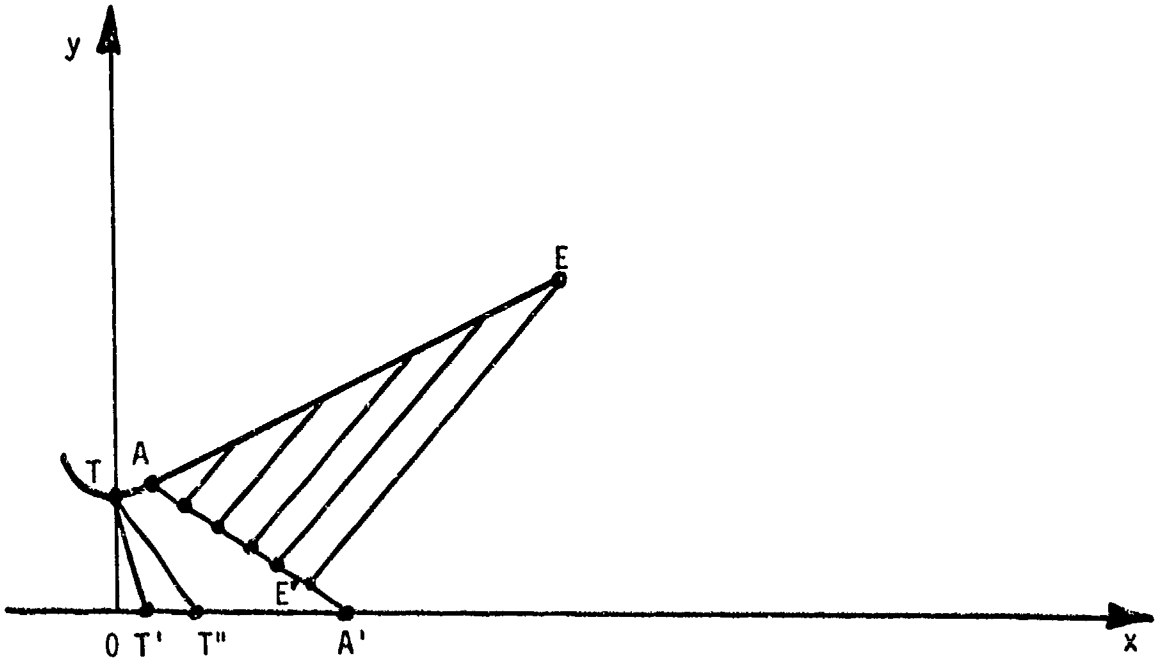


Figure 29. Mode 2 Mach line network.

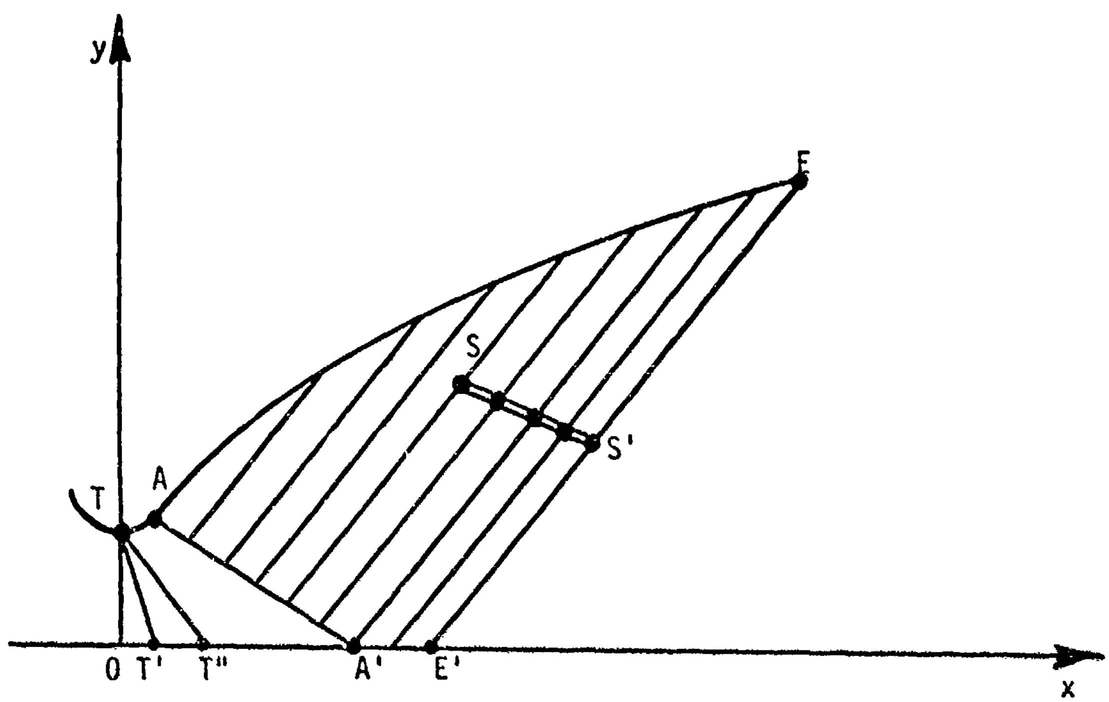


Figure 30. Mode 3 Mach line network.

expansion flowfield illustrated in Figure 26 is first constructed. Left-running Mach lines are then originated from line AA'. These left-running Mach lines are continued until they intersect the nozzle wall, contour AE. The point of initiation, point S, of the right-running oblique shock wave SS' must be specified in terms of its (I,J) characteristic coordinates. Subsequent left-running Mach lines pass through the oblique shock wave, which is illustrated as a double line in Figure 30. The location and properties of the oblique shock wave are determined simultaneously with the construction of the left-running Mach line network. Left-running Mach line E'E, which passes through the nozzle exit lip point, point E, defines the downstream extent of the nozzle flowfield.

Mode 4. This mode analyzes the flowfield in a nozzle with a scarfed nozzle extension in which an attached right-running oblique shock wave emanates from the junction between the basic nozzle and the nozzle extension, point E. The flowfield is constructed along a network of left-running Mach lines, as illustrated in Figure 31. The initial expansion flowfield illustrated in Figure 26 is first constructed. Left-running Mach lines are then originated from line AA'. These left-running Mach lines are continued until they intersect the nozzle wall, contour AE. Left-running Mach line E'E, which passes through the nozzle exit lip point, point E, defines the flow properties at point E. An attached right-running oblique shock wave is originated from point E. Subsequent left-running Mach lines pass through the oblique shock wave. The location and properties of the oblique shock wave are determined simultaneously with the construction of the left-running Mach line

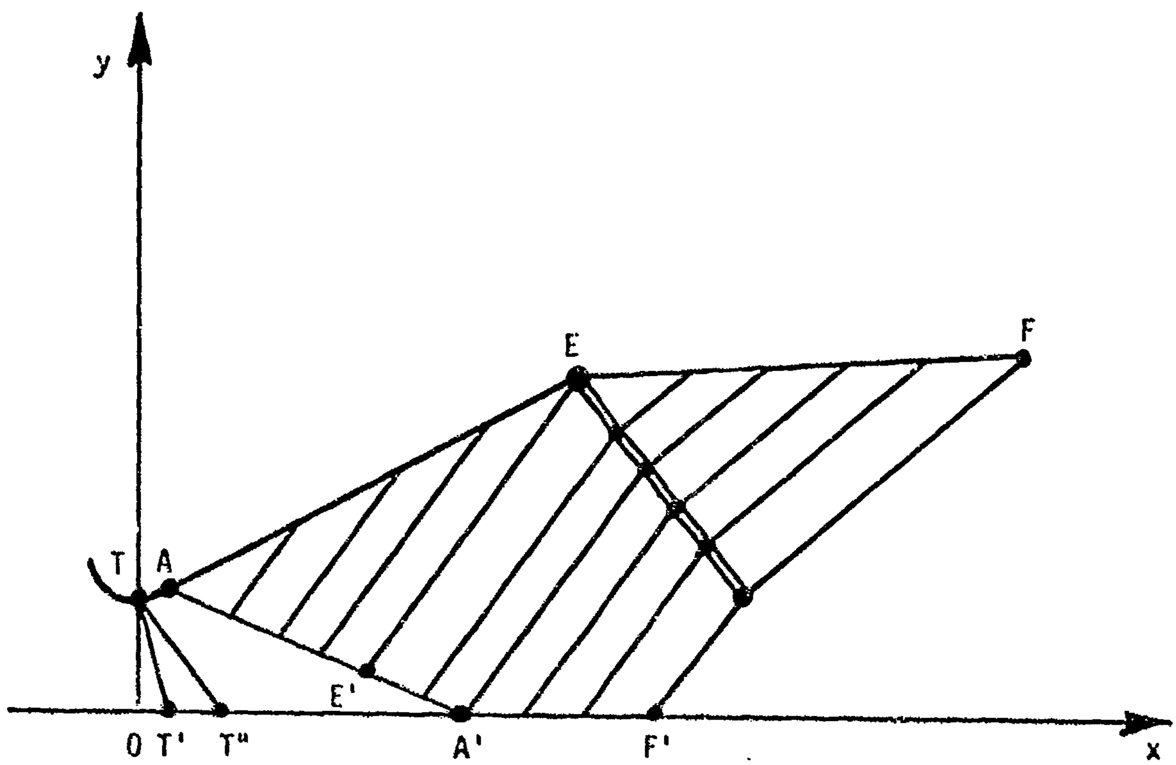


Figure 31. Mode 4 Mach line network.

network. Left-running Mach line F'F, which passes through point F, the exit lip point of the nozzle extension, defines the downstream extent of the flowfield in the scarfed nozzle extension.

Mode 5. This mode is identical to the fourth mode described in the previous paragraph, except that the initial expansion flowfield illustrated in Figure 27 is employed instead of the initial expansion flowfield illustrated in Figure 26. The remainder of the flowfield is constructed exactly as described in the previous paragraph. The resulting flowfield is illustrated in Figure 32.

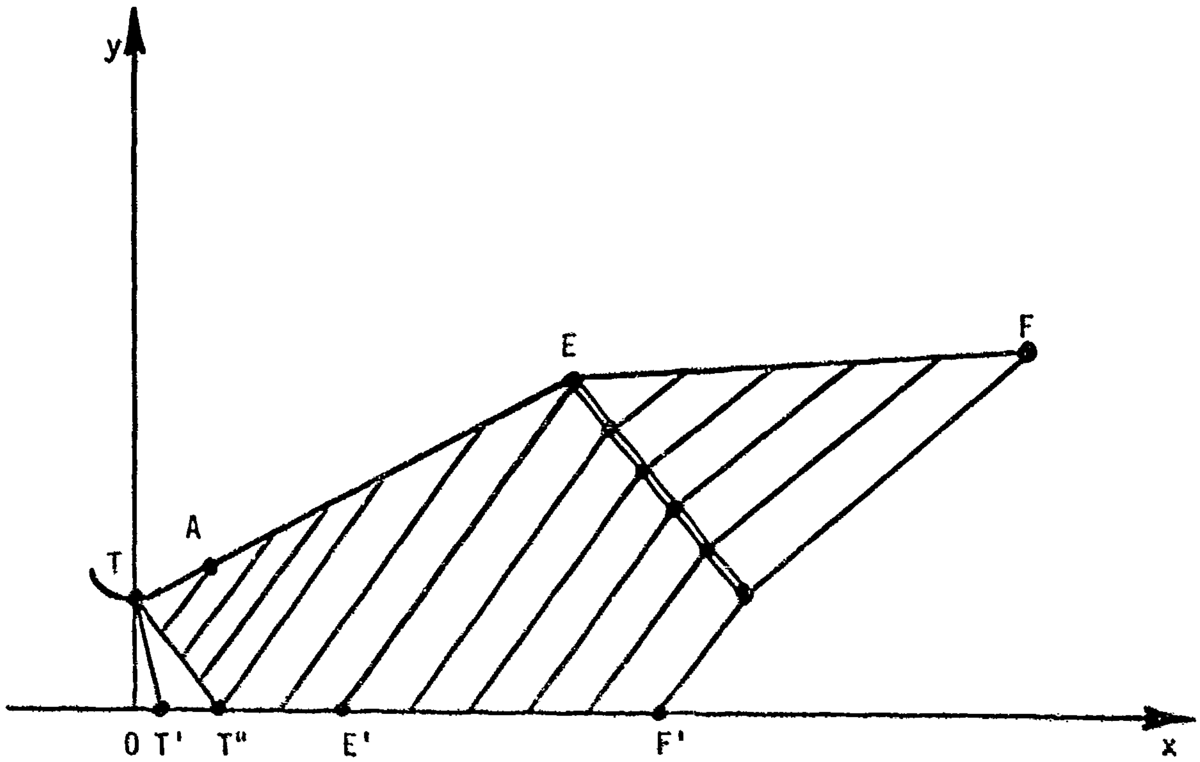


Figure 32. Mode 5 Mach line network.

2. PROBLEM SPECIFICATIONS

The first step in the procedure is the specification of the problem to be analyzed. The nozzle geometric model must be specified as described in Section II and illustrated in Figure 25. The nozzle throat is specified by the throat radius y_t, the throat upstream radius of curvature ρ_{tu} which is employed in the transonic flow analysis, and the throat downstream radius of curvature ρ_{td} which controls the initial supersonic expansion. The x location of the nozzle throat is chosen to be 0.0.

The basic nozzle supersonic contour, $y(x)$, attaches smoothly to the throat contour at the attachment angle θ_a. The length of the basic nozzle is x_e. If the supersonic expansion contour is conical, the cone angle must be equal to θ_a. A conical nozzle of length x_e is completely specified by any one of the variables θ_a, y_e, or ε. If the supersonic contour is quadratic, θ_a and x_e must be specified. Then, one of the variables θ_e, y_e, or ε completes the specification of the quadratic nozzle. For the tabular nozzle, a set of (x,y) pairs must span the region from point A to point E. The first point in the table must be the first point downstream of point A. The last point in the table becomes point E. The basic nozzle geometry is described in the computer program in subroutine BØUNDYE.

The conical extension is specified completely by the values of x_f and θ_f. The geometry of the conical extension is described in the computer program in subroutine BØUNDYW.

The gas thermodynamic model is specified by the gas specific heat ratio γ and the gas constant R. Subroutines THERMOI and THERMOR

evaluate the equations of state for a thermally and calorically perfect gas flowing in an irrotational and rotational flowfield, respectively.

The nozzle operating conditions are specified by the stagnation pressure P_t, the stagnation temperature T_t, and the ambient pressure P_a.

The parameters described in the above paragraphs completely specify a specific nozzle and its operating conditions. Numerous other parameters must be specified to enable a numerical solution of the flowfield. Those parameters are described in the following paragraphs as they are encountered.

The input data are read into the computer program by subroutine INPUT in overlay LINK10.

3. INITIAL-VALUE LINE

The first step in the numerical solution is the determination of a supersonic initial-value line spanning the nozzle throat region from which the method of characteristics solution for the supersonic flowfield can be initiated. Two options for obtaining a supersonic initial-value line are contained in the computer program. The first option is an internally generated initial-value line. The second option is to input a tabular initial-value line obtained from any other source.

A. Internally Generated Initial-Value Line

The internally generated initial-value line is based on Kliegel's analysis [Reference (2)]. That transonic flowfield model is described in Section III.2. The only additional information required to specify the location of the initial-value line are the number of points desired and the spacing of those points. The first point is the point on the nozzle axis (ε, 0.0), and the last point is the nozzle throat point (0.0, y_t).

The total number of points on the initial-value line is NI. These NI points may be spaced uniformly along the initial-value line, or they may be spaced according to a geometric progression in Δy so that the ratio of the final Δy adjacent to the nozzle wall to the initial Δy adjacent to the nozzle axis is given by the parameter DYRATIO. This latter option, spacing according to a geometric progression, is useful when either throat radius of curvature, ρ_{tu} or ρ_{td}, is small compared to the throat radius y_t, so that large gradients in flow properties occur adjacent to the nozzle wall in the throat region.

Figure 33 illustrates a typical initial-value line determined by the present algorithm.

B. Tabular Initial-Value Line

The supersonic initial-value line may be determined from any external source and read into the computer program in tabular form. The order of the tabular data must be consistent with the order in which the data are stored and used by the remainder of the program. The first tabular point must be the nozzle axis point, point T', and the last tabular point must be the nozzle wall point, point T. The number of points and their spacing is arbitrary.

The tabular initial-value line is specified by the number of points on the line, NI, the location of the points (i.e., x and y), and the Mach number M and flow angle θ at each point. From this information, the remainder of the flow properties at each point are calculated internally (i.e., P, ρ, T, V, u, and v).

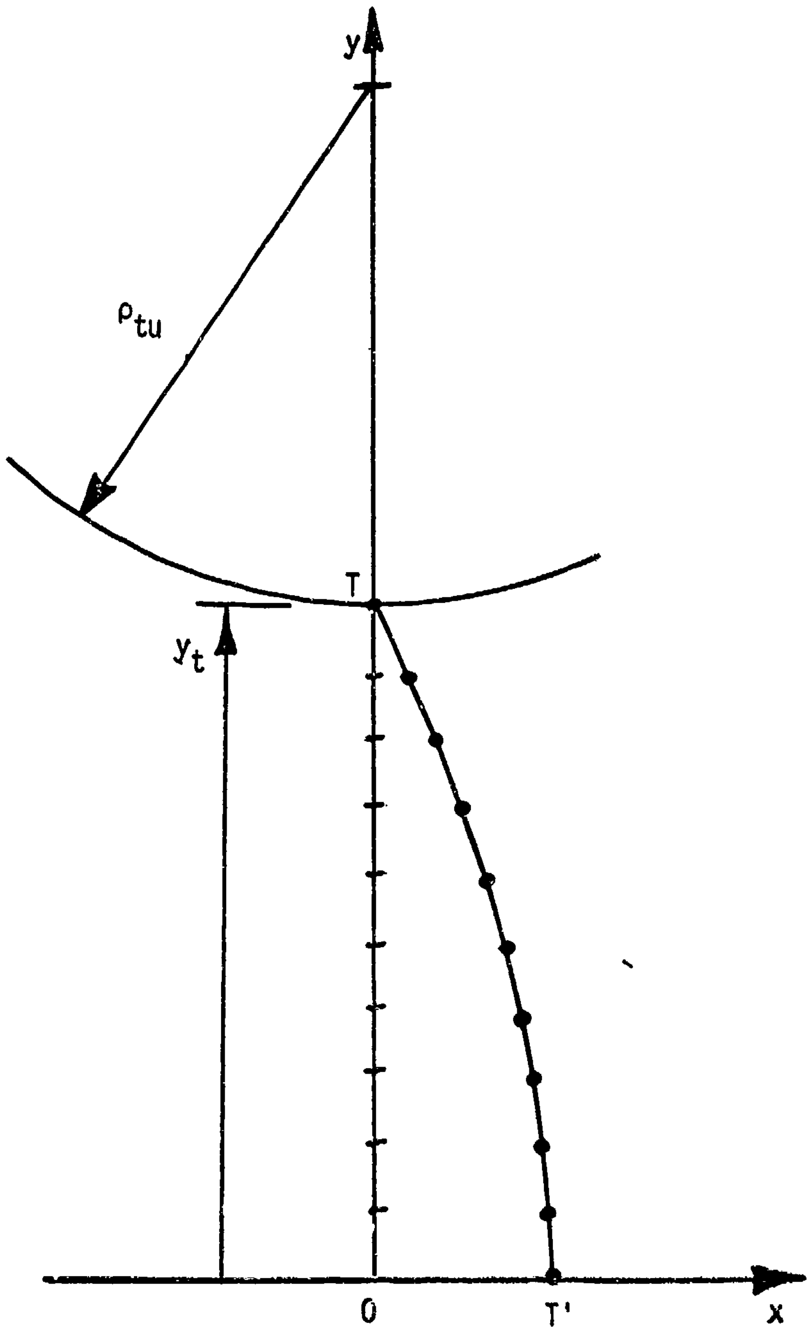


Figure 33. Supersonic initial-value line.

4. FLOWFIELD FROM THE INITIAL-VALUE LINE

The flowfield model in the basic nozzle is described in Section III.3. The numerical solution for this flowfield is obtained by applying the method of characteristics for steady two-dimensional irrotational supersonic flow. That procedure is implemented by constructing left-running and right-running Mach lines, starting from the initial-value line, until they crisscross the entire supersonic flowfield. The solution of the flowfield from the initial-value line is described in this section.

Figure 34 illustrates schematically the application of the unit process for an interior point at the first two points located on the lower portion of the initial-value line, for determining the location of and the flow properties at the downstream point of intersection of the two Mach lines emanating from the two initial-value line points. Figure 35 illustrates schematically the application of the unit process for an axis point, for determining the location of and the flow properties at the downstream point of intersection of the right-running Mach line from the interior point and the nozzle axis.

The foregoing procedure is repeated from the next two points on the initial-value line, thus extending the corresponding right-running Mach line to the nozzle axis. The procedure is repeated until the complete region determined by the initial-value line has been determined. Figure 36 illustrates the resulting network of Mach lines emanating from the initial-value line. The flowfield from the initial-value line is now complete. To continue the solution further, the wall boundary conditions must be employed.

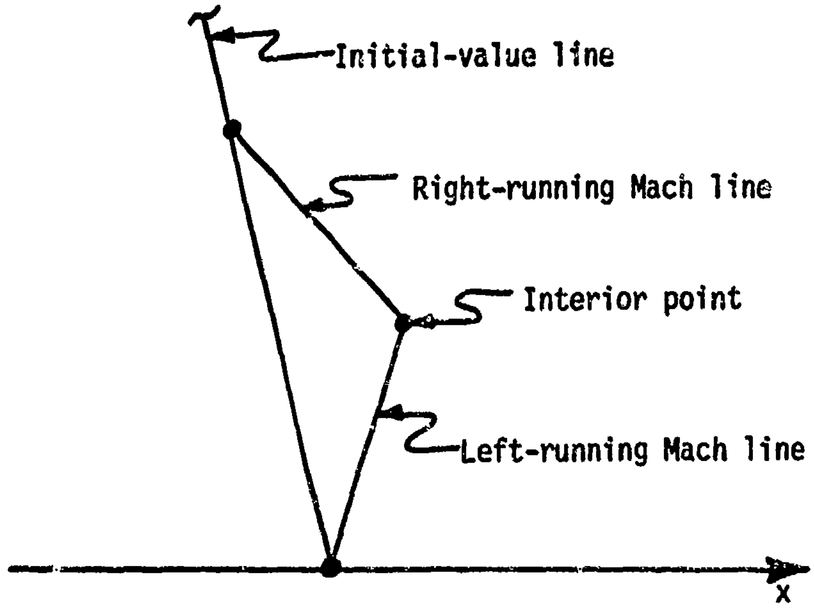


Figure 34. Application of the unit process for an interior point from the first two points on the initial-value line.

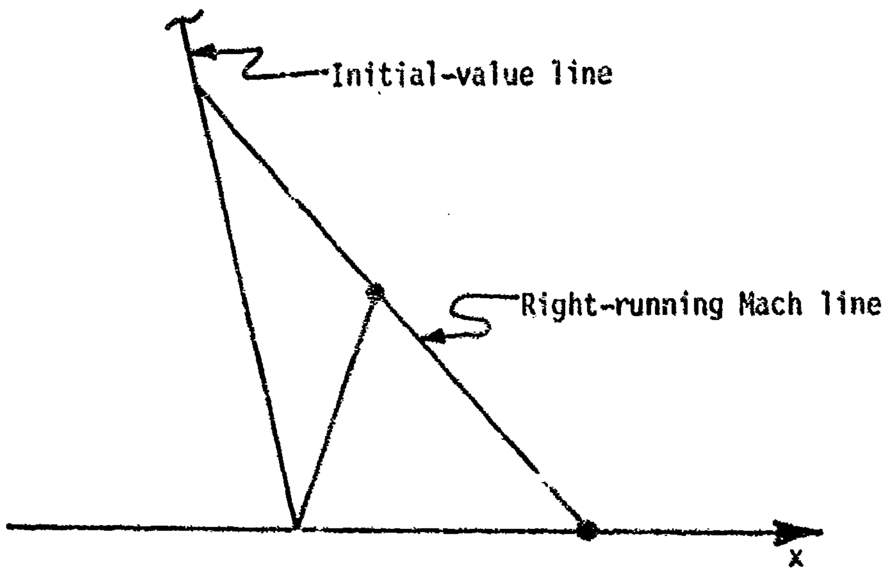


Figure 35. Application of the unit process for an axis point.

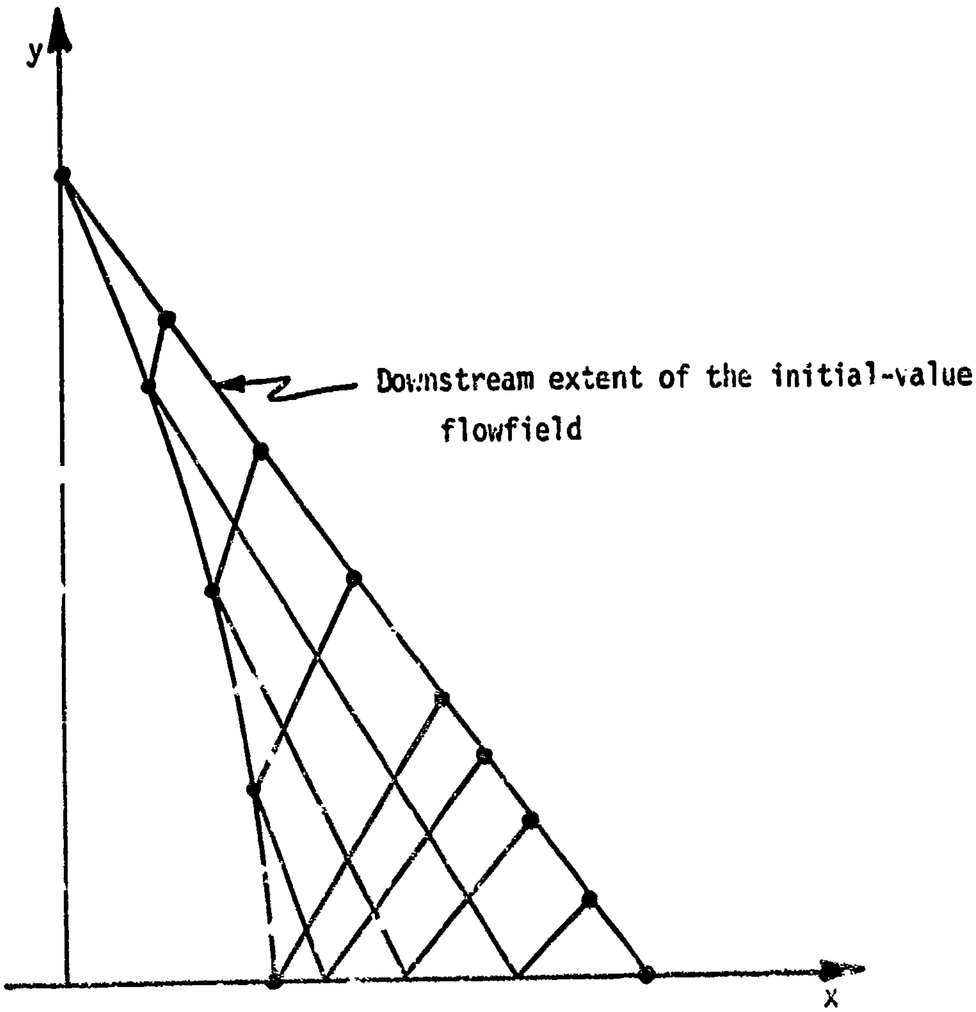


Figure 36. Extent of the initial-value problem.

In the computer program, the logic described in this section for determining the flowfield from the initial-value line is implemented by subroutine MOCIVL in overlay LINK20.

5. FLOWFIELD FROM THE CIRCULAR ARC THROAT

The flowfield from the circular arc throat is determined by prespecifying the number and location of points along the circular arc, and then applying the method of characteristics to determine the flow propertires at those points. Two different Mach line network construction procedures are available for determining the flow properties along the initial expansion contour.

The first Mach line network construction procedure constructs right-running Mach lines from the prespecified points along the circular arc throat contour. These right-running Mach lines are propagated across the flowfield to the nozzle axis just as the right-running Mach lines from the initial-value line points were propagated to the nozzle axis (see Section V.4). This procedure is continued until the right-running Mach line from point A, the attachment point between the circular arc throat and the supersonic expansion contour, has been constructed. This Mach line network, illustrated in Figure 26, is used for MODE = 1 to 4, as discussed in Section V.1 and illustrated in Figures 28 to 31.

The second Mach line network construction procedure constructs left-running Mach lines from the right-running Mach line at the downstream extent of the flowfield from the initial-value line, illustrated in Figure 36. These left-running Mach lines are propagated across the flowfield to the circular arc throat contour. This procedure is continued until a left-running Mach passes downstream of the last prespecified wall point on the circular arc throat contour, point A. This Mach line network, illustrated in Figure 27, is used for MODE = 5, as discussed in Section

V.1 and illustrated in Figure 32.

The total turning angle along the circular arc throat is θ_a. A number of points are prespecified along the circular arc contour. The first point is a point just downstream of the throat point (i.e., point T), and the last point is the attachment point between the circular arc throat and the supersonic contour (i.e., point A). The only additional information required to specify the location of these points are the number of points desired and the spacing of those points.

The total number of points on the circular arc throat (not including the throat point, point T) is NT. These NT points may be spaced along the circular arc in equal angular increments, or they may be spaced according to a geometric progression in $\Delta\theta$ so that the ratio of the final $\Delta\theta$ adjacent to point A to the initial $\Delta\theta$ adjacent to point T is given by the parameters DARATIO. This latter option, spacing according to a geometric progression, is useful when the throat downstream radius of curvature ρ_{td} is small compared to y_t, so that large gradients in flow properties occur adjacent to the nozzle wall along the circular arc contour. Figure 37 illustrates a typical distribution of points along the throat downstream circular arc contour.

Figure 38 illustrates schematically the application of the inverse wall point unit process to determine the first prespecified point on the throat downstream circular arc contour. A left-running Mach line is projected rearward from the prespecified wall point to intersect the previous right-running Mach line, as illustrated in Figure 38. If the point of intersection falls below the second point, then the point of intersection is assumed to fall between the second and third points, as

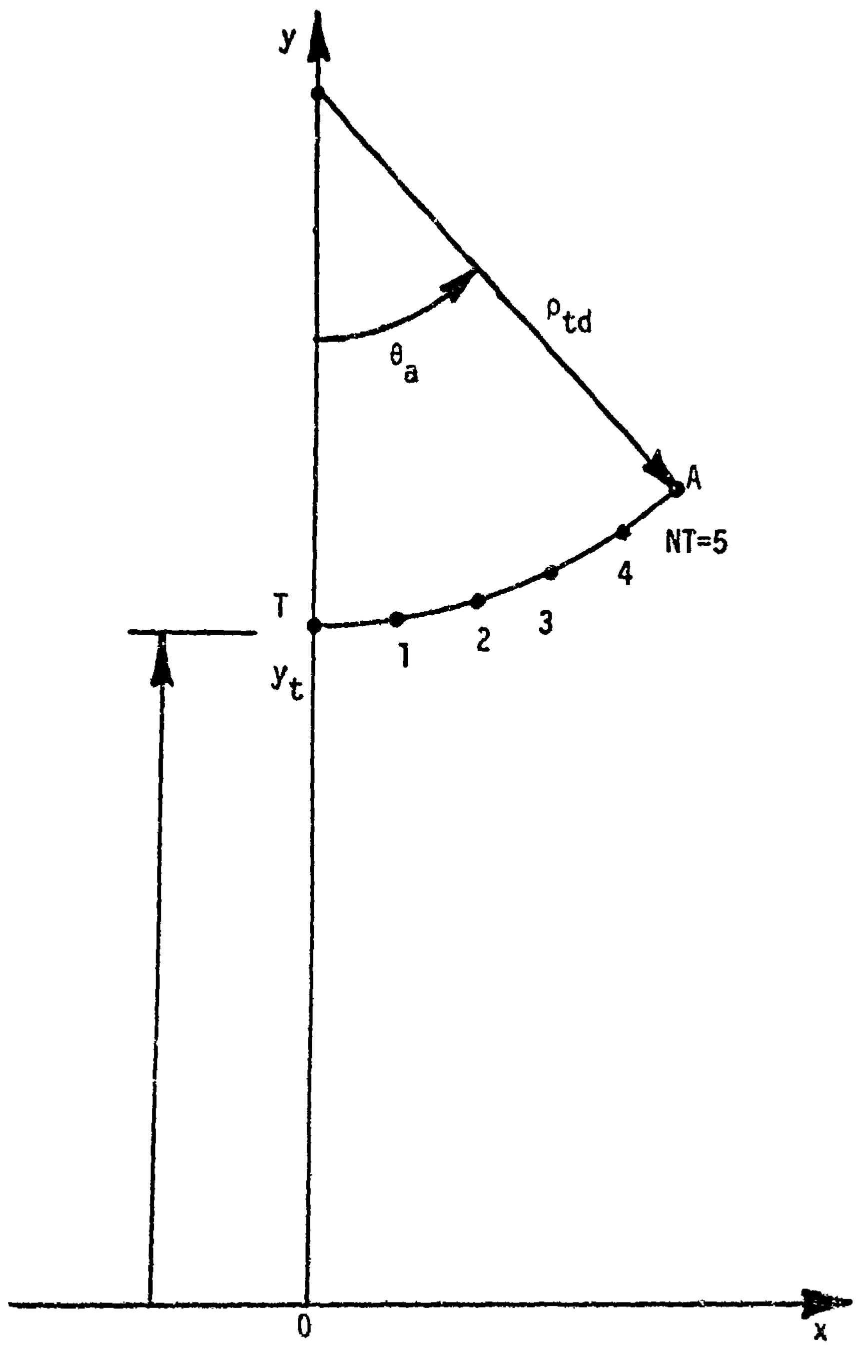


Figure 37. Distribution of points along the throat downstream circular arc contour.

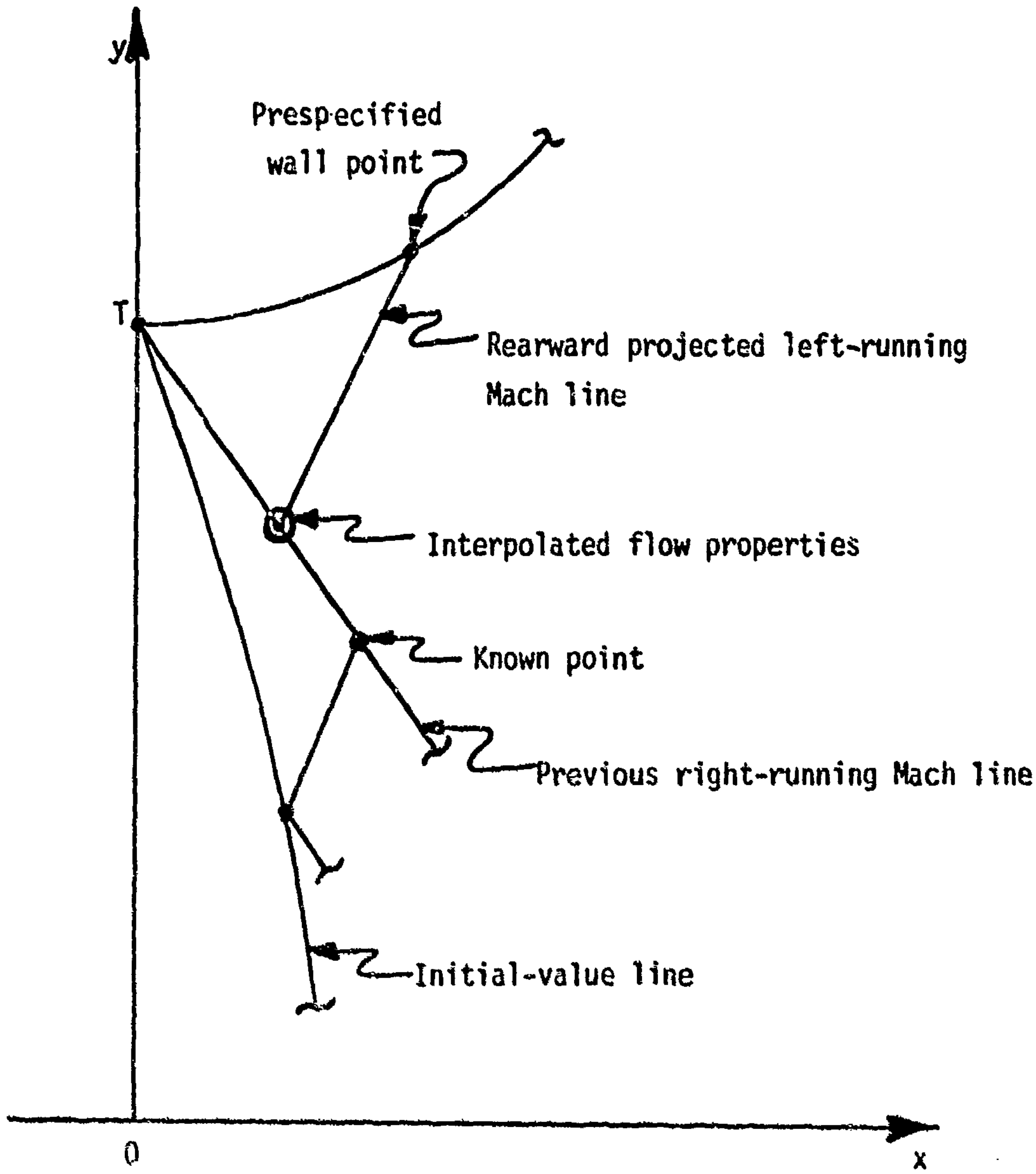


Figure 38. Application of the inverse wall point unit process.

illustrated in Figure 39. This procedure is continued until the two points bracketing the rearward projected left-running Mach line are located. In most cases, these two points are the first two points on the previous right-running Mach line. The flow properties at the point of intersection are then calculated by linear interpolation. The flow properties at the prespecified wall point are then found by applying the compatibility relation along the left-running Mach line and the solid wall boundary conditions.

The above procedure for determining the first inverse wall point is the same for both of the Mach line network construction procedures described at the beginning of this section. From here on, however, the two procedures are different. They are described in the next two sections.

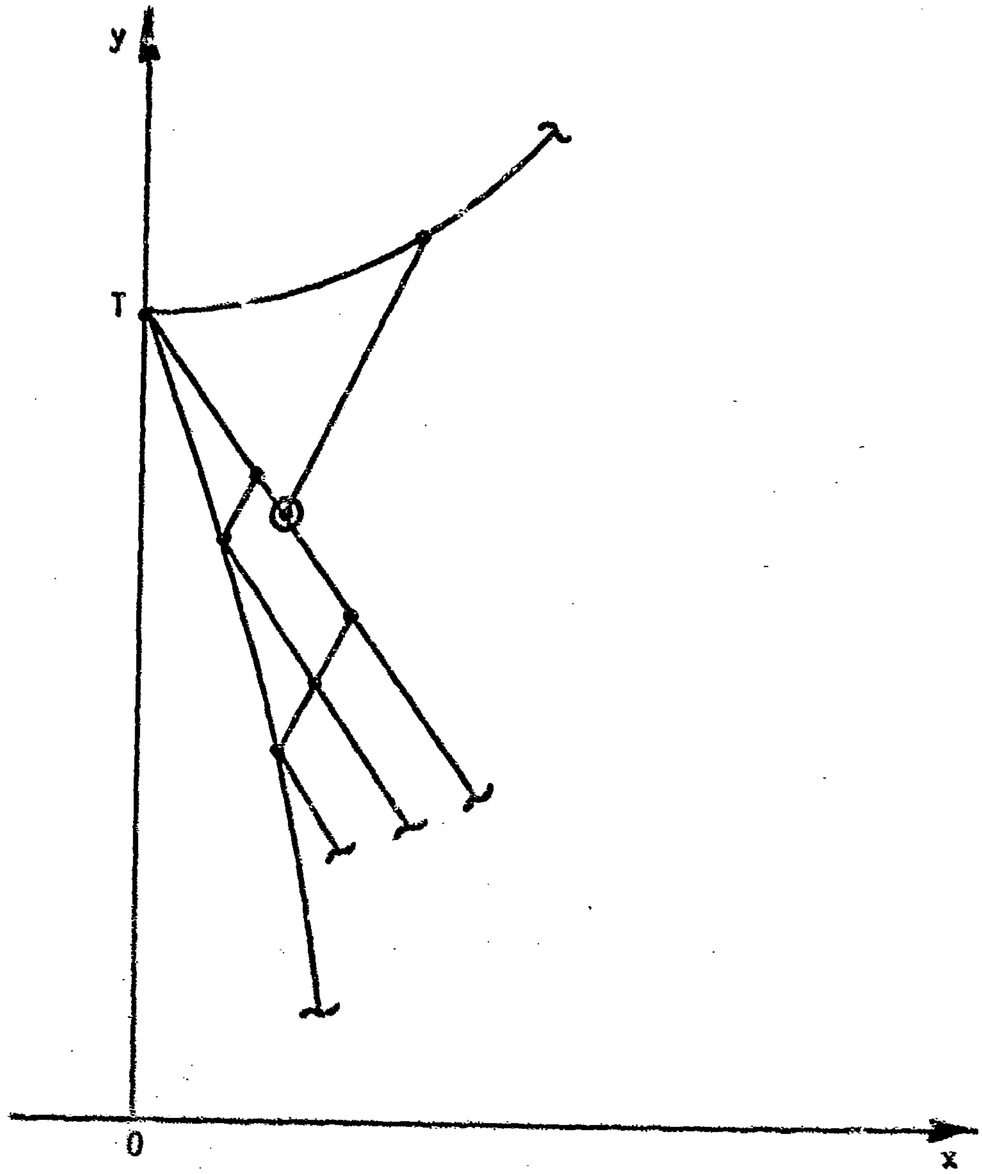


Figure 39. Modification of the inverse wall point unit process.

5. RIGHT-RUNNING MACH LINE NETWORK FROM THE CIRCULAR ARC THROAT

Once the solution for the inverse wall point has been obtained, as illustrated in Figure 38, a right-running Mach line is originated from the inverse wall point and continued until it intersects the nozzle axis, as described in Section V.4 for the right-running Mach lines emanating from points on the initial-value line. The above procedure is repeated at each successive prespecified wall point on the nozzle circular arc throat contour until the region of the flowfield determined by that portion of the nozzle contour has been determined. Figure 40 illustrates the resulting network of Mach lines emanating from the nozzle circular arc throat contour. In the computer program, the logic described in this section is implemented in subroutine MOCARCR in overlay LINK20.

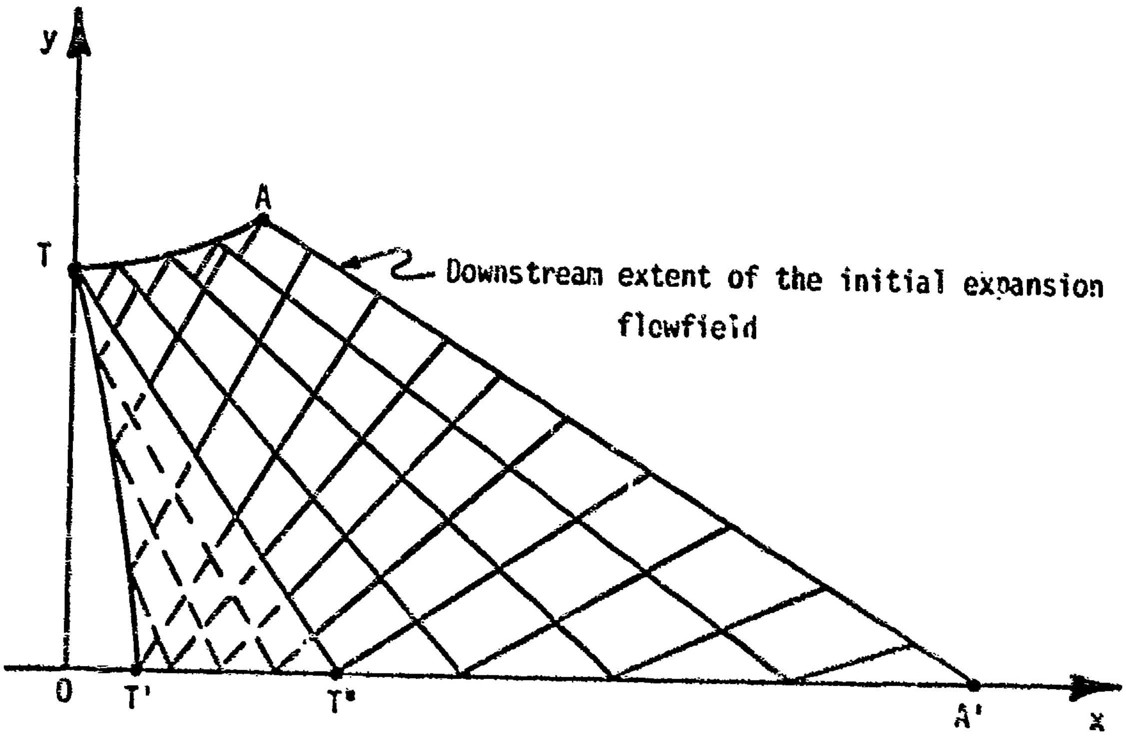


Figure 40. Extent of the flowfield determined by the nozzle circular arc throat contour.

7. CHARACTERISTIC COORDINATE SYSTEM

By this point, it should be obvious that the numerical solution is being obtained along the network of left-running and right-running Mach lines that crisscross the flowfield. One of the major advantages of the numerical method of characteristics is that numerical information propagates along the Mach lines, which are the actual paths of propagation of physical information. Consequently, the Mach line network provides an instant view of the domain of dependence and range of influence of each and every point in the flowfield. Hence, it is very useful to be able to identify specific individual Mach lines in a flowfield.

The identification of individual Mach lines is accomplished in the numerical solution by employing a characteristic coordinate system, as illustrated in Figure 41. The characteristic coordinate system consists of the right-running Mach lines, called I characteristics, and the left-running Mach lines, called J characteristics. The characteristic coordinate system is obviously not an orthogonal coordinate system, but a curvilinear coordinate system composed of the right-running and left-running Mach lines.

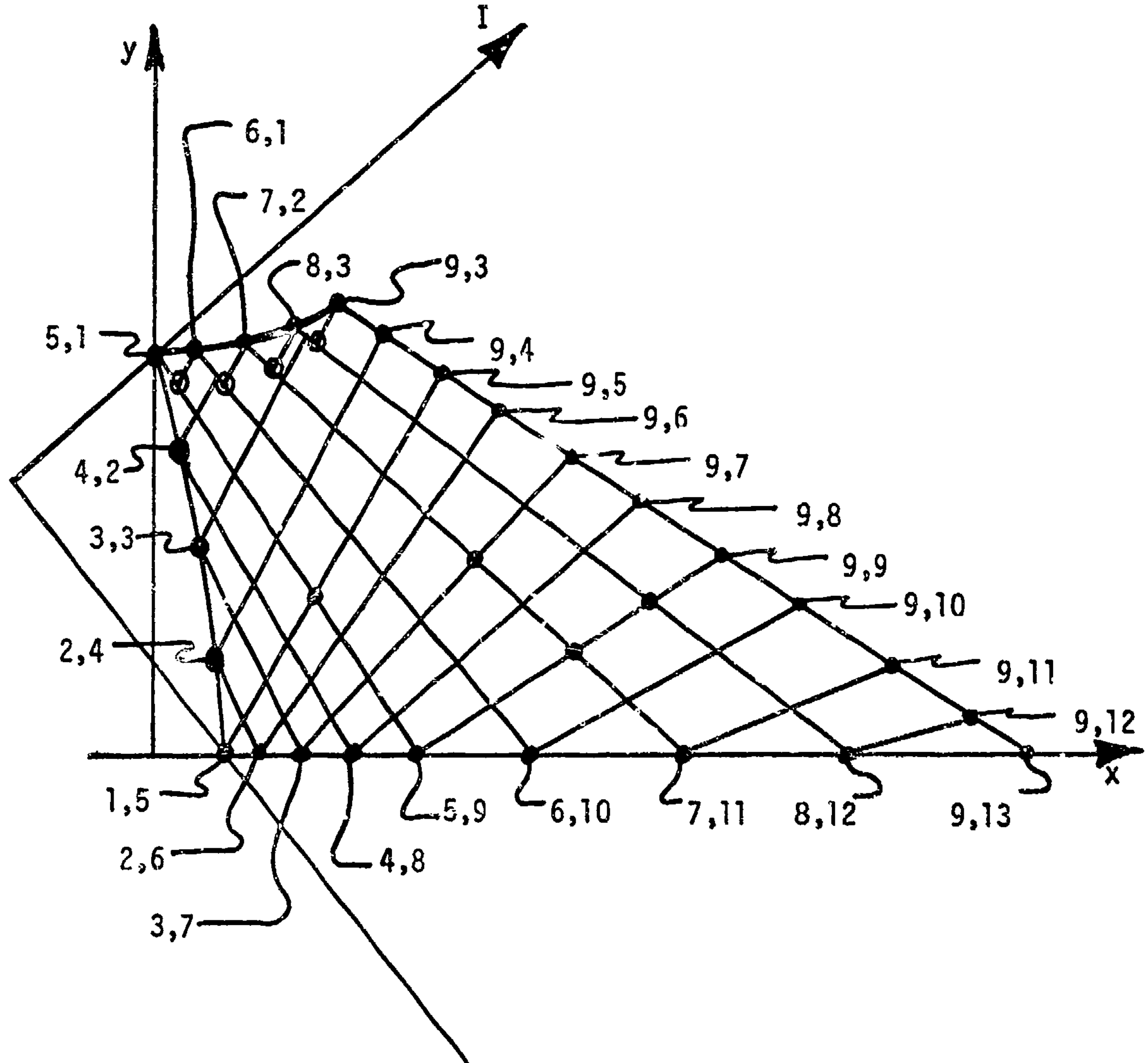


Figure 41. Characteristic coordinate system.

In the characteristic coordinate system, the right-running Mach lines are numbered starting at one for the point on the initial-value line at the nozzle axis, and increasing by one for each succeeding right-running Mach line. The left-running Mach lines are numbered starting at one for the point on the initial-value line at the nozzle throat, and increasing by one for each succeeding left-running Mach line. By following a constant value of the I or J characteristic coordinate through the flowfield, a unique right-running or left-running Mach line can be traced from its point of origin to its final point in the flowfield. The influence of initial-value line points and wall points on the flowfield can be easily tracked in this manner.

To illustrate the characteristic coordinate system further, several special points are considered. The coordinates of the point on the initial-value line at the nozzle axis are (1, NI), and the coordinates of the point at the nozzle throat are (NI, 1). The coordinates of all of the initial-value line points are specified on Figure 41, where NI = 5. Note that points (1,1) to (1,4), (2,1) to (2,3), (3,1), (3,2), and (4,1) are not defined.

The first prespecified wall point has an I value of NI + 1. The corresponding J value is that of the left-running Mach line just above the rearward projected left-running Mach line through the wall point. Consequently, the J value of a prespecified wall point is the same as the J value of the previous wall point when the rearward projected left-running Mach line intersects the previous right-running Mach line between the first two points on that Mach line. When that intersection point falls between the second and third point, the J value of the

prespecified wall point is one greater than the J value of the previous prespecified wall point. The coordinates of the prespecified wall points are presented on Figure 41. Clearly, as left-running Mach lines intersect the wall and dissappear from the Mach line network, the characteristic coordinate system reflects this situation by the increasing J values of the wall points.

On the nozzle axis, right-running Mach lines from the initial-value line or the nozzle wall intersect the axis and left-running Mach lines are initiated from the intersection point and propagated into the flowfield. Thus, new left-running characteristics having increasing J values are generated from the nozzle axis. The coordinates of the axis points are specified on Figure 41.

The characteristic coordinates of all of the interior points are simply the I and J values of the right-running and left-running Mach lines that intersect at each point. The coordinates of the interior points along the right-running Mach line from the last prespecified wall point illustrated in Figure 41 are specified to illustrate the coordinates for interior points. The coordinates of several other interior points are specified on Figure 41 for illustration.

8. LEFT-RUNNING MACH LINE NETWORK ADJACENT TO THE CIRCULAR ARC THROAT

The first step in determining a left-running Mach line network along the initial expansion contour is the same as the procedure illustrated in Figure 38. After determining the first inverse wall point, the right-running Mach line emanating from that point is extended into the flowfield to find its point of intersection with the left-running Mach line just below the interpolated point on the previous right-running Mach line. That left-running Mach line becomes the control left-running Mach line in the following procedure.

So far, this procedure is identical to the procedure presented in Section V.6. However, instead of continuing the right-running Mach line to the nozzle axis as desribed in Section V.6, the next inverse wall point is determined, as illustrated in Figure 42. The right-running Mach line emanating from that inverse wall point is then extended into the flowfield to intersect the control left-running Mach.

This procedure is continued from succeeding prespecified inverse wall points until the point of intersection of the rearward projected left-running Mach line from the next inverse wall point and the previous right-running Mach line lies below the control left-running Mach line, as illustrated in Figure 42. At that point, that particular control left-running Mach line is complete, and the entire procedure is repeated, starting from the next point on the last right-running Mach line at the downstream extent of the initial-value flowfield.

The above procedure is repeated from succeeding points on the right-running Mach line at the downstream extent of the initial-value flowfield

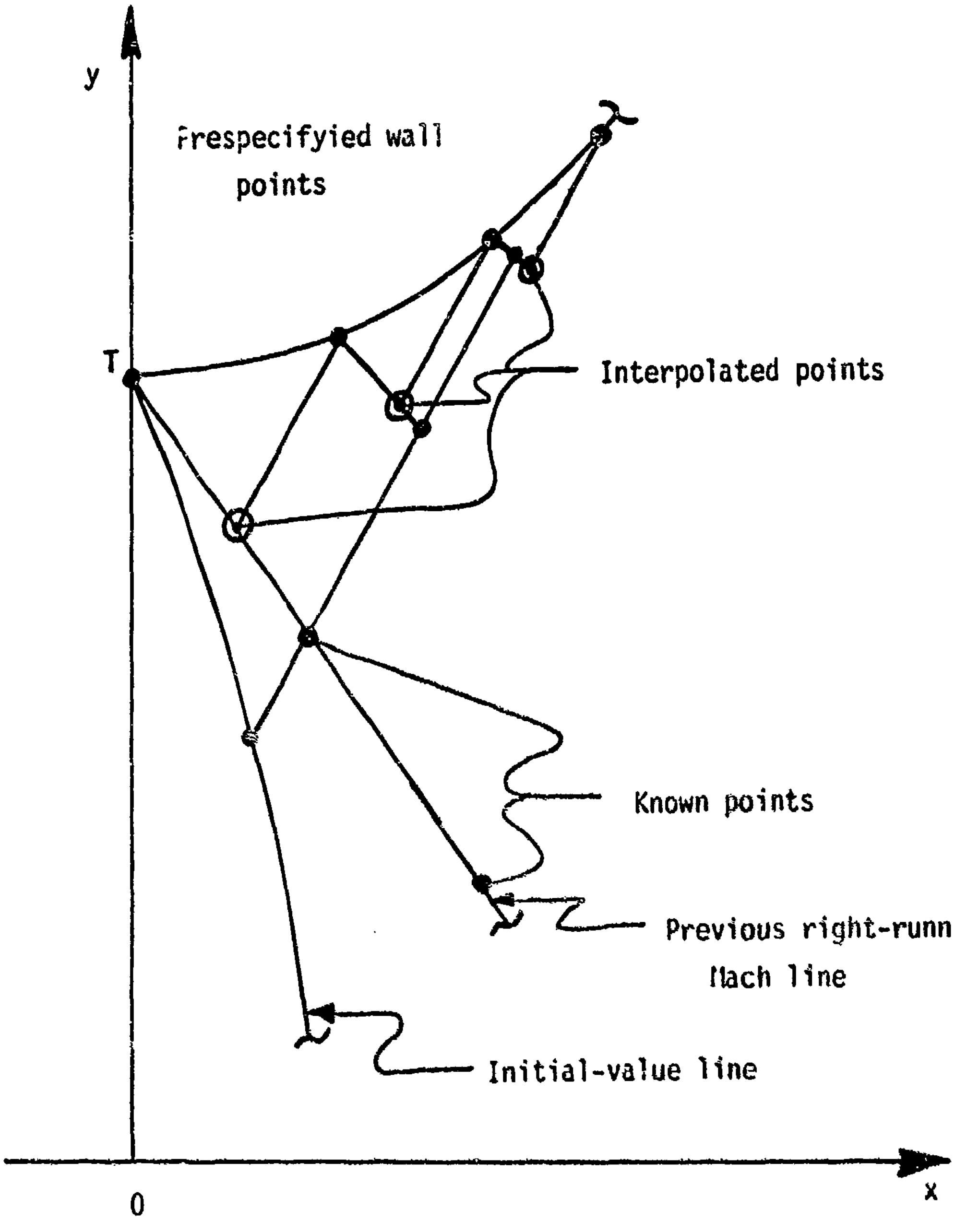


Figure 42. Modified application of the inverse wall point unit process.

until the last prespecified inverse wall point has been determined. The final control left-running Mach line is then extended forward, by the direct wall point unit process, to intersect the supersonic turning contour. Figure 43 illustrates the resulting network of Mach lines. This Mach line network is employed when analyzing a scarfed nozzle by MODE = 5. In the computer program, the logic described in this section is implemented in subroutine MOCARCL in overlay LINK20.

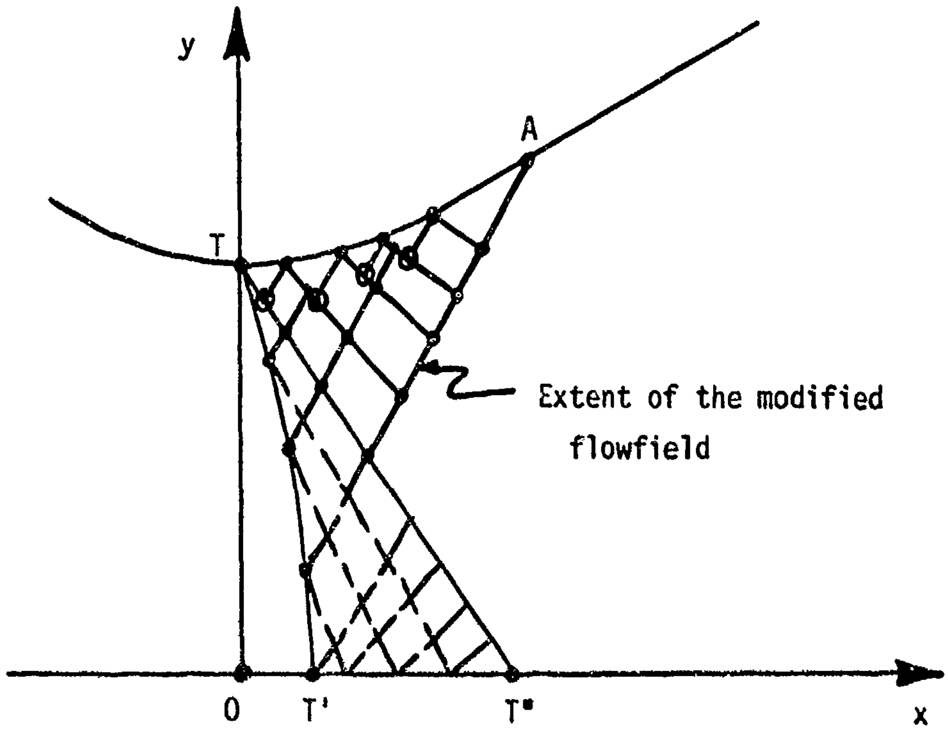


Figure 43. Extent of the modified flowfield determined by the nozzle circular arc throat contour.

9. RIGHT-RUNNING MACH LINE NETWORK IN THE BASIC NOZZLE

The flowfield from the supersonic contour (i.e., conical, quadratic, or tabular contour) is determined by extending a left-running Mach line from the second point on the right-running Mach line emanating from the previous wall point until it intersects the supersonic contour. The flow properties at the point of intersection are determined by the method of characteristics. A right-running Mach line is then emanated from the wall points. The right-running Mach line is propagated across the flowfield to the nozzle axis just as the right-running Mach lines from the initial-value line (see Section V.4) and right-running Mach lines from the throat circular arc contour (see Section V.6) were propagated to the nozzle axis. This procedure is continued until the intersection of the left-running Mach line from the previous right-running Mach line and the supersonic contour falls on the projection of the supersonic contour beyond the end point of the basic nozzle, point E. The flow properties at point E are determined by the inverse wall point method described in Section V.4. The final right-running Mach line from point E is propagated to the nozzle axis, thus completing the flowfield determined by the basic nozzle supersonic contour.

Figure 44 illustrates schematically the application of the direct wall point unit process to determine the first point on the supersonic contour just downstream of the attachment point, point A, where the throat circular arc contour joins the supersonic contour. The flow properties at the direct wall point are then found by applying the compatibility relation along the left-running Mach line and the solid wall boundary conditions. This procedure is implemented in the computer

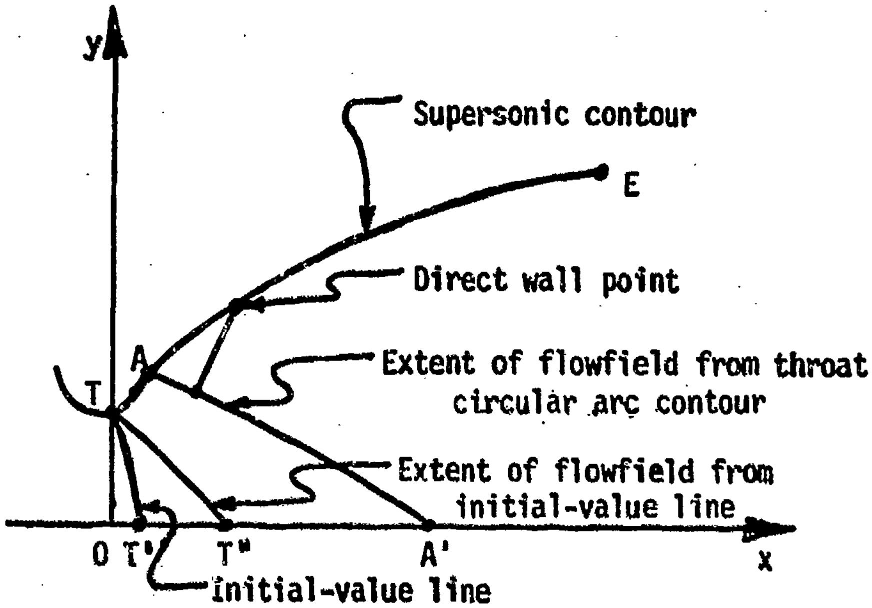


Figure 44. Application of the direct wall point unit process.

program by subroutine DRWALLI and BOUNDYE in overlay LINK20.

The complete flowfield along right-running Mach lines emanating from the supersonic contour of the basic nozzle is illustrated schematically in Figure 45. This Mach line network is employed when analyzing a basic nozzle (MODE = 1) or a basic nozzle with an embedded right-running oblique shock wave (MODE = 3). In the computer program, the logic described in this section is implemented in subroutine MOCRRC in overlay LINK20.

The procedure described above is very straightforward in a continuous flowfield. However, when compression waves are present they tend to coalesce, and if enough coalescence occurs, oblique shock waves are formed. The coalescence of Mach lines and the appearance of oblique shock waves complicates both the flowfield itself and the logic procedure described above for calculating the flowfield. In the present investigation, the assumption is made that no strong oblique shock waves occur in the basic nozzle.

When right-running Mach lines coalesce (i.e., cross), the original Mach line is retained and the new Mach line is terminated downstream of the point of crossing. This procedure is illustrated in Figure 46. Since the computational logic is based on following right-running Mach lines across the flowfield from the nozzle wall to the nozzle axis, each Mach line must reach the nozzle axis. The above manner of handling crossing Mach lines achieves that goal. The new Mach line thus consists of the new points calculated before the point of crossing and the old points downstream of the point of crossing. Thus, the new Mach line completely spans the nozzle flowfield from the nozzle wall to the nozzle axis. In

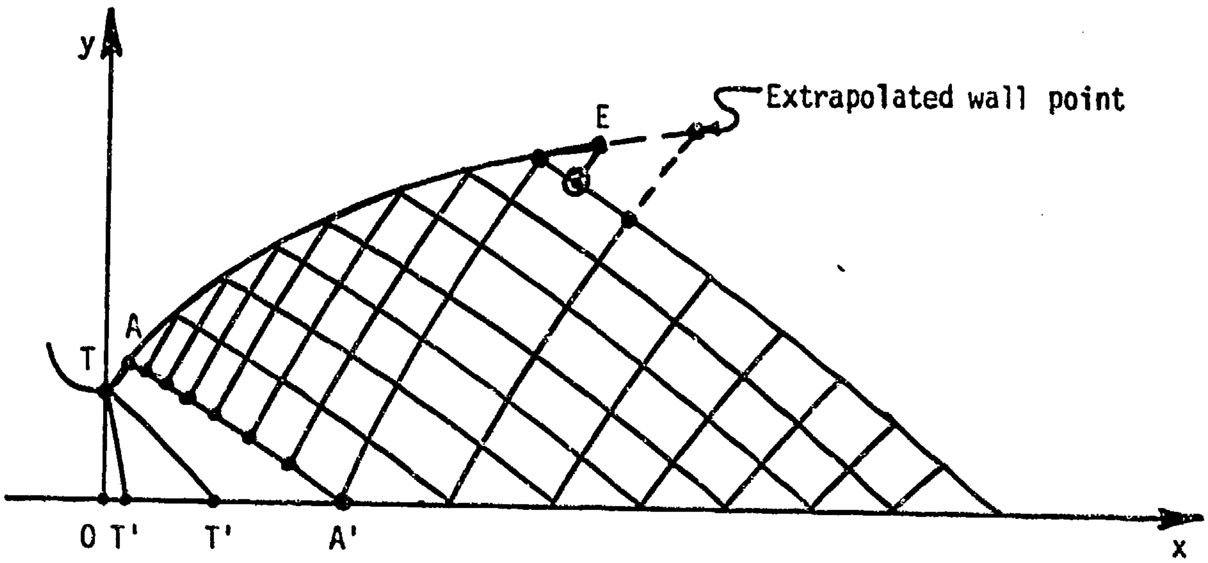


Figure 45. Extent of the right-running Mach line network along the basic nozzle contour.

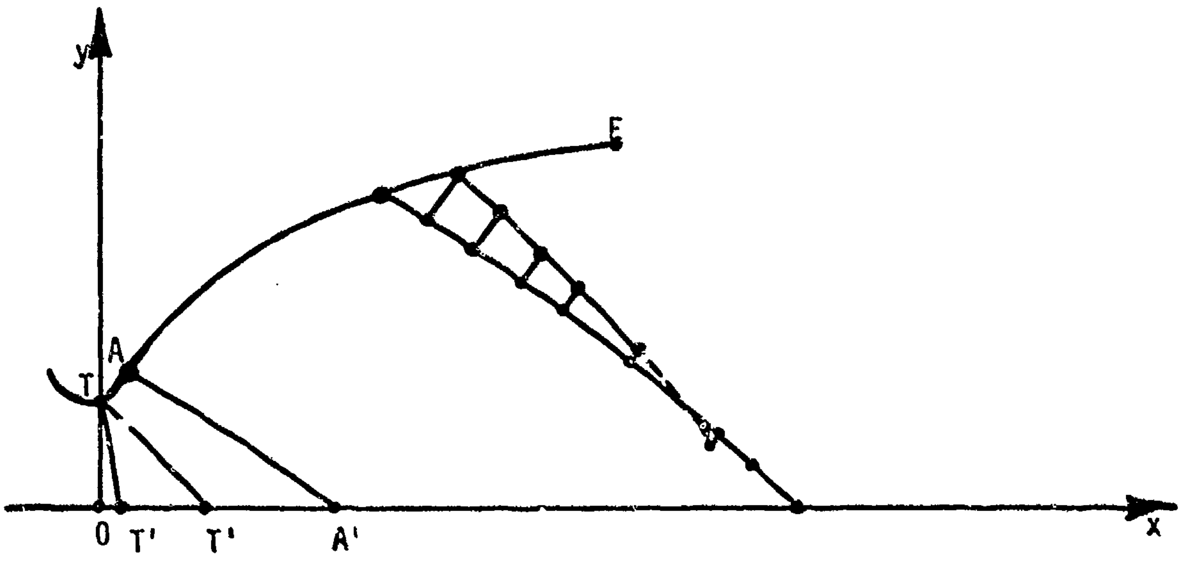


Figure 46. Crossing right-running Mach lines.

the computer program output, the points downstream of the point of crossing are written out as the solution for both right-running Mach lines.

When left-running Mach lines cross, the new Mach line is terminated. Since the computational logic is based on following right-running Mach lines across the flowfield instead of following left-running Mach lines, no further action is necessary when left-running Mach lines cross. This procedure is illustrated in Figure 47. Essentially, the left-running Mach line that crossed its upstream neighbor has been assumed to cease to exist. This would create errors in the (I,J) characteristic coordinate system if it were not accounted for. In the present computer program, when a left-running Mach line crosses its upstream neighbor, the solution is aborted and the x location of the solution point is specified by -1.0. The aborted point is given a location in the solution storage arrays and the (I,J) characteristic coordinate system. That left-running Mach line then acts like a phantom Mach line until it passes out of the flowfield at the nozzle wall, as illustrated in Figure 48. In any particular flowfield, several phantom left-running Mach lines may exist simultaneously, adjacent to each other or separated by real left-running Mach lines. In the computer program output, these phantom points are written out with their I,J characteristic coordinates and a blank line of data.

The occurence of crossed right-running Mach lines and phantom left-running Mach lines considerably complicates the program logic. However, the procedure described above works very well and gives very accurate results as long as the Mach line crossings are not too numerous.

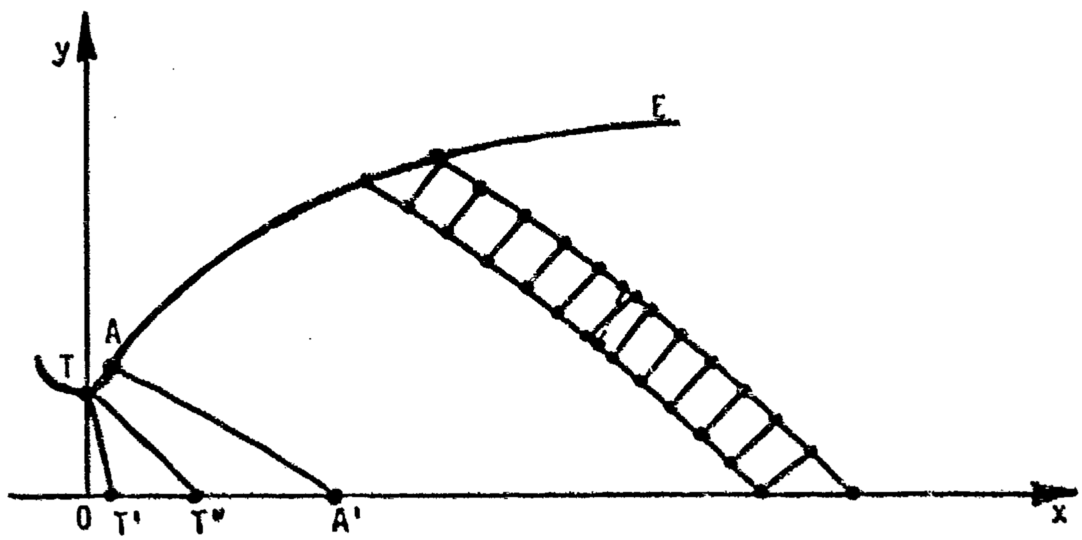


Figure 47. Crossing left-running Mach lines.

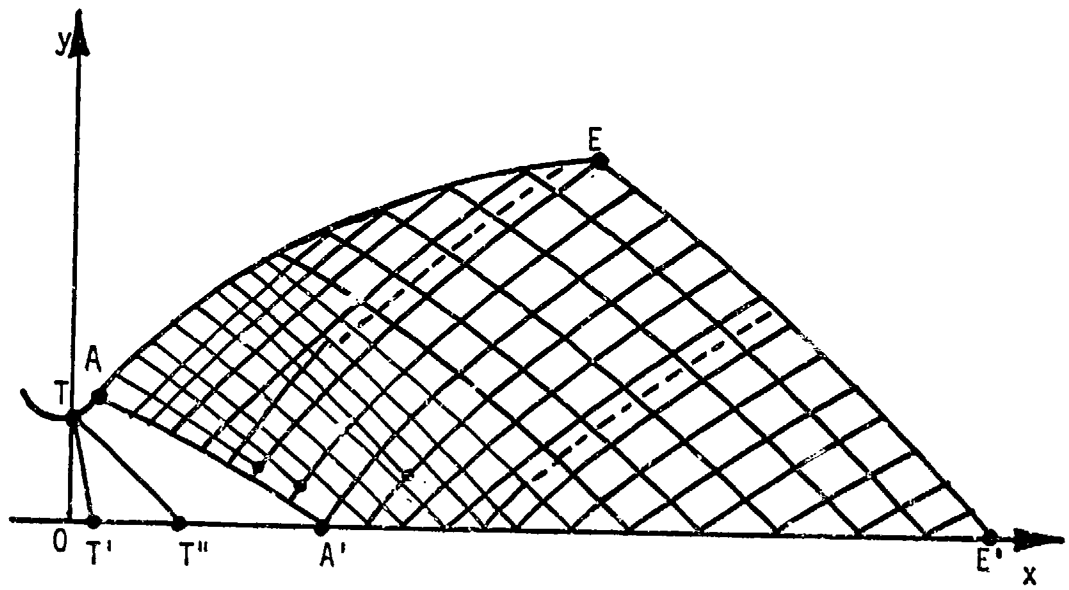


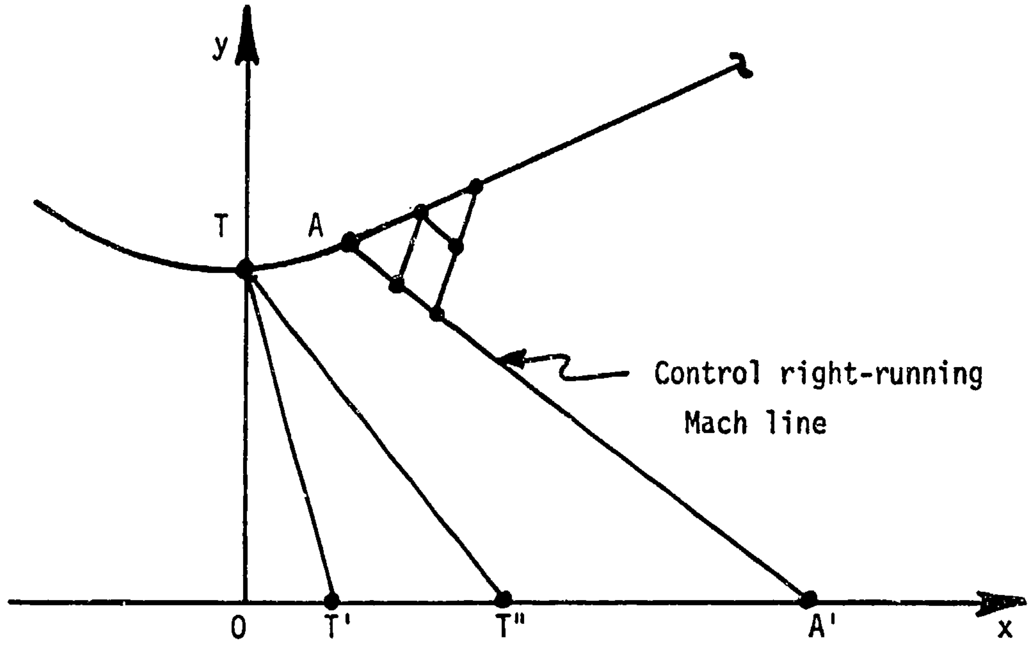
Figure 48. Propagation of phantom left-running Mach lines.

10. LEFT-RUNNING MACH LINE NETWORK IN THE BASIC NOZZLE

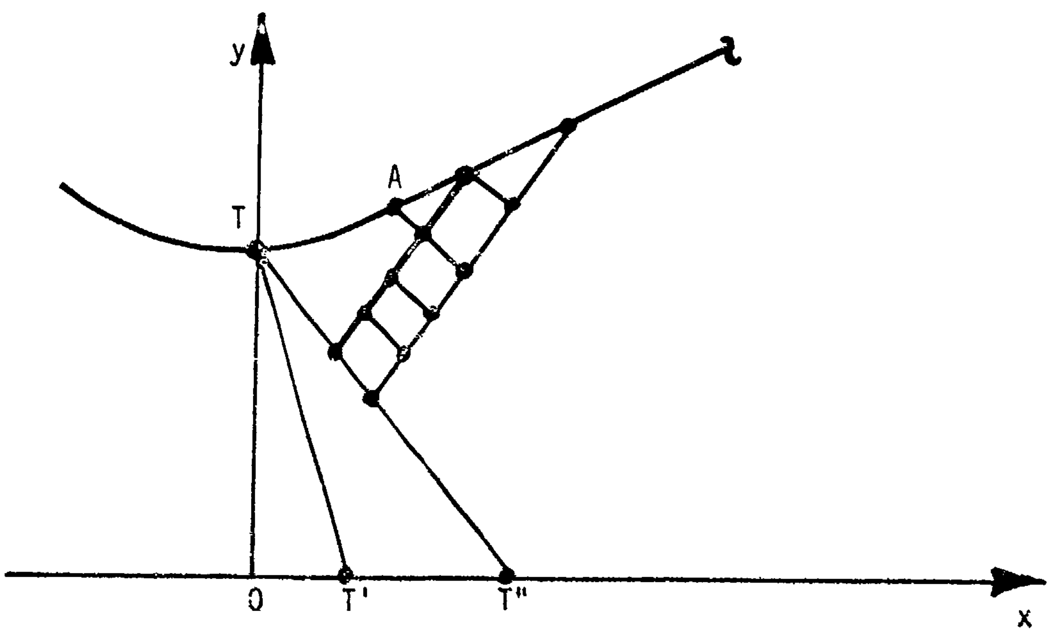
A left-running Mach line network can be constructed in the basic nozzle starting from either line AA', illustrated in Figure 40, or line TT", illustrated in Figure 43. Modes 2, 3, and 4, described in Section V.2, construct left-running Mach line networks starting from line AA'. Mode 5 constructs a left-running Mach line network starting from line TT". Those two network construction procedures are described in this section.

When the left-running Mach line network construction procedure illustrated in Figure 40 is employed, the flowfield is constructed along left-running Mach lines emanating from the last right-running Mach line at the downstream extent of the initial expansion flowfield. That right-running Mach line is called the control right-running Mach line. Starting from the flowfield illustrated in Figure 40, a left-running Mach line is initiated from the second point on the control right-running Mach line. That left-running Mach line is continued upward until it intersects the nozzle wall, as illustrated in Figure 49(a).

This procedure is repeated from successive points along the control right-running Mach line until one of two events occurs: (1) a left-running Mach line from the last point (i.e., the point on the axis) on the control right-running Mach line has been generated, or (2) the intersection of the left-running Mach line and the supersonic contour falls on the projection of the supersonic contour beyond the end of the basic nozzle, point E. In the first case, an axis point is determined as illustrated in Figure 35, and the next left-running Mach line emanates from that axis point. In the second case, the flow properties at point E



(a) Starting from line AA'.



(b) Starting from line TT".

Figure 49. Propagation of a left-running Mach line to the basic nozzle wall.

are determined by the inverse wall point method described in Section V.4. This completes the flowfield determined by the basic nozzle contour.

When the left-running Mach line network construction procedure illustrated in Figure 43 is employed, the flowfield is constructed along left-running Mach lines emanating from the last right-running Mach line at the downstream extent of the flowfield from the initial-value line, line TT'. That right-running Mach line is called the control right-running Mach line. Enough left-running Mach lines have already been initiated from the control right-running Mach line to determine the flow properties along the initial expansion contour, contour TA. That procedure is discussed in Section V.8 and illustrated in Figure 42.

The procedure described in Section V.8 is continued from successive points along the control right-running Mach line. Each successive left-running Mach line is continued upward until it intersects the nozzle wall, as illustrated in Figure 49(b). The procedure from here on is identical to that described above where line AA' is the control right-running Mach line.

The flowfield determined by either of the two aforementioned Mach line network construction procedures is illustrated schematically in Figure 50. This Mach line network construction procedure is employed when analyzing a basic nozzle (MODE = 2), a basic nozzle with an embedded right-running oblique shock wave (MODE = 3), or a scarfed nozzle with an attached right-running oblique shock wave (MODE = 4 or 5). In the computer program, the logic described in this section is implemented in subroutine MOCLRCI in overlay LINK20.

The procedure described above is very straightforward in a

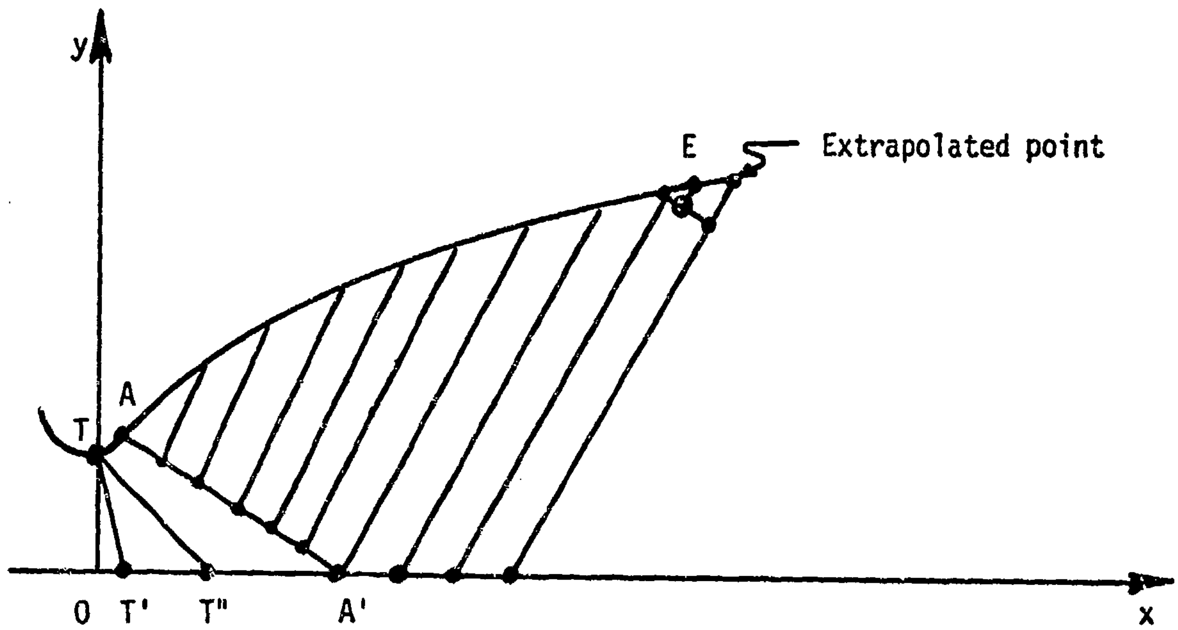


Figure 50. Extent of the left-running Mach line network along the basic nozzle contour.

continuous flowfield. However, when compression waves are present they tend to coalesce, and if enough coalescence occurs, oblique shock waves are formed. The coalescence of Mach lines and the appearance of oblique shock waves complicates both the flowfield itself and the logic procedure described above for calculating the flowfield. In the present investigation, the assumption is made that no strong oblique shock waves occur in the basic nozzle.

When left-running Mach lines coalesce (i.e., cross), the original Mach line is retained and the new Mach line is terminated downstream of the point of crossing. This procedure is illustrated in Figure 51. Since the computational logic is based on following left-running Mach lines across the flowfield from the downstream extent of the initial value flowfield or the nozzle axis to the nozzle wall, each left-running Mach line must reach the nozzle wall. The above manner of handling crossing Mach lines achieves that goal. The new Mach line thus consists of the new points calculated before the point of crossing and the old points after the point of crossing. Thus, the new Mach line completely spans the nozzle flowfield from the downstream extent of the initial value flowfield or the nozzle axis to the nozzle wall. In the computer program output, the points after the point of crossing are written out as the solution for both left-running Mach lines.

When right-running Mach lines cross, the new Mach line is terminated. Since the computational logic is based on following left-running Mach lines across the flowfield instead of following right-running Mach lines, no further action is necessary when right-running Mach lines cross. This procedure is illustrated in Figure 52. Essentially, the right-running

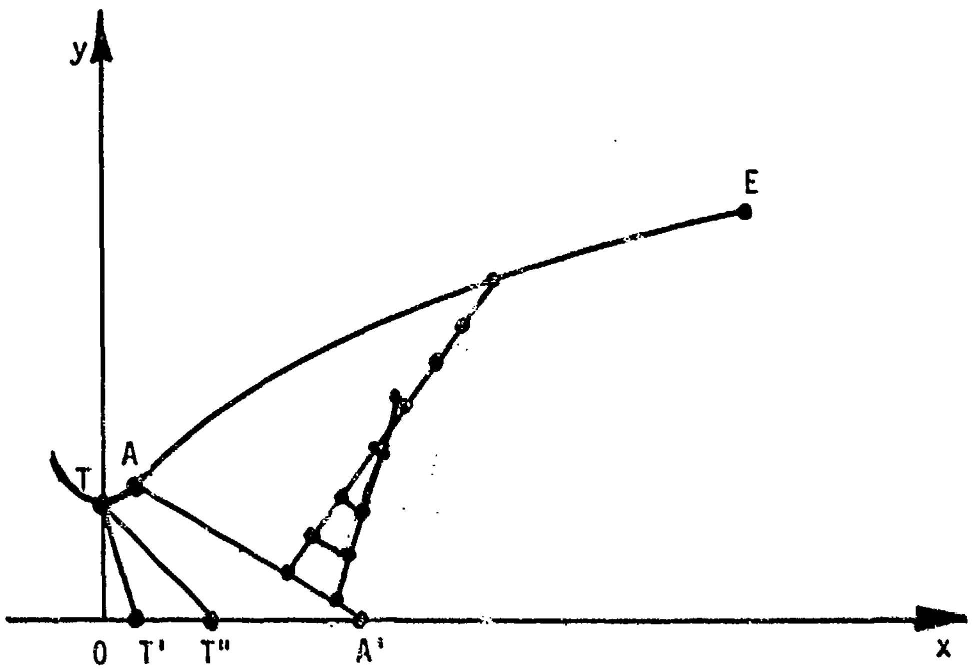


Figure 51. Crossing left-running Mach lines.

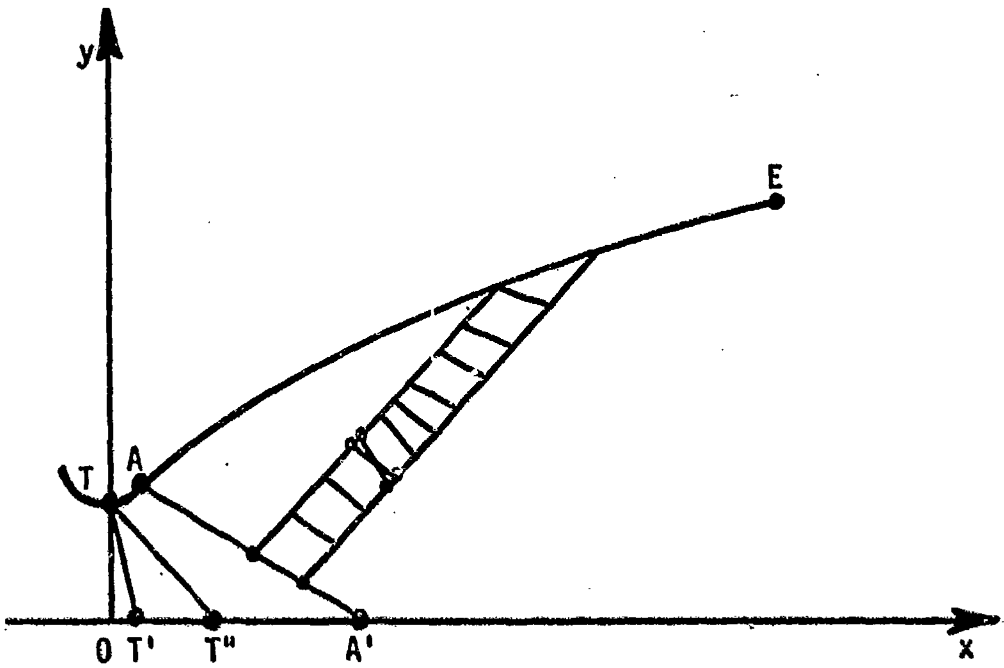


Figure 52. Crossing right-running Mach lines.

Mach line that crossed its upstream neighbor has been assumed to cease to exist. This would create errors in the (I,J) characteristic coordinate system if it were not accounted for. In the present computer program, when a right-running Mach line crosses its upstream neighbor, the solution is aborted and the x location of the solution point is specified by -1.0. The aborted point is given a location in the solution storage arrays and the (I,J) characteristic coordinate system. That right-running Mach line then acts like a phantom Mach line until it passes out of the flowfield at the nozzle axis, as illustrated in Figure 53. In any particular flowfield, several phantom left-running Mach lines may exist simultaneously, adjacent to each other or separated by real left-running Mach lines. In the computer program output, these phantom points are written out with their I,J characteristic coordinates and a blank line of data.

The occurence of crossed left-running Mach lines and phantom right-running Mach lines considerably complicates the program logic. However, the procedure described above works very well and gives very accurate results as long as the Mach line crossings are not too numerous.

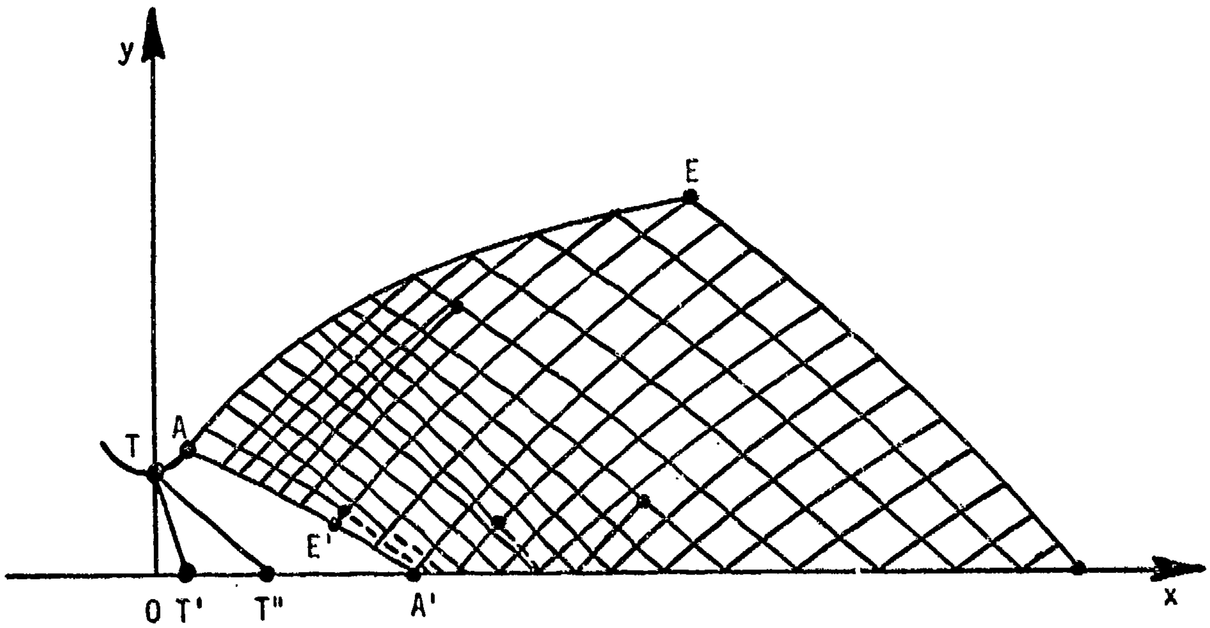


Figure 53. Propagation of phantom right-running Mach lines.

11. OBLIQUE SHOCK WAVE

An oblique shock emanates from the junction point of the basic nozzle and the nozzle extension, point E in Figure 25. This oblique shock wave propagates upstream into the flowfield emanating from the supersonic contour of the basic nozzle. The flowfield model for this oblique shock wave is presented in Section III.3. The implementation of that flowfield model into the overall numerical algorithm is discussed in the present section.

The first step in the determination of the oblique shock wave is the determination of the wave angle ε and the flow properties on the downstream side of the oblique shock wave at point E itself. This is accomplished by assuming a value for the wave angle ε, solving for the flow turning angle δ from equation (77), and comparing the resulting flow angle (i.e., $\theta_e - \delta$) with the angle of the conical extension (i.e., θ_f). The wave angle ε is varied iteratively until $(\theta_e - \delta)$ converges to θ_f within a prespecified convergence tolerance. The downstream Mach number M_2 is then determined from equations (74) to (76), and the remaining flow properties are determined from equations (78) to (82). This completes the solution for the oblique shock wave at point E.

One small modification in the characteristic network is made before the oblique shock wave solution is initiated. The interpolated point at the intersection of the reward projection of the left-running Mach line through point E is substituted into the solution arrays in place of the point just below it, as illustrated in Figure 54.

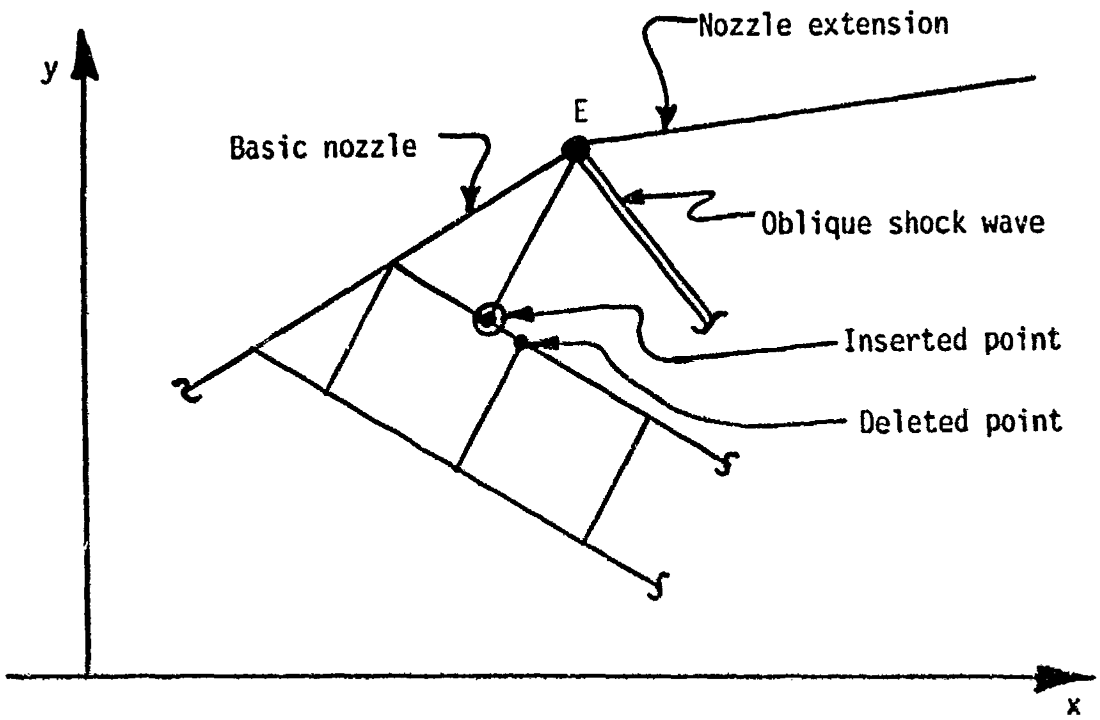


Figure 54. Insertion of interpolated point in the solution arrays.

The next step in determining the flowfield downstream of the oblique shock wave is to initiate a left-running Mach line from the next point on the right-running Mach line at the downstream extent of the upstream flowfield or from the nozzle axis if the upstream flowfield has reached the axis. That left-running Mach line is then propagated toward the scarfed nozzle extension until it reaches the oblique shock wave. It penetrates the oblique shock wave and continues until it intersects the scarfed nozzle extension, as illustrated in Figure 55.

The numerical procedure for obtaining the solution at the intersection of the left-running Mach line and the oblique shock wave is presented in Section III.4.C. The application of that model to the first point on the oblique shock wave downstream of point E is illustrated in Figure 56. The circled points are temporary points inserted on rearward projected right-running Mach lines. The shock wave point is located at the downstream intersection of the oblique shock wave from point E and the left-running Mach line from the upstream flowfield. The oblique shock wave is illustrated schematically as a double line to indicate that there are two sets of flow properties at each point on the shock wave; the upstream properties determined by application of the upstream interior point unit process and the downstream properties determined by the oblique shock wave equations. The first wall point downstream of point E is also determined during the iterative procedure for the shock wave angle at the shock wave point.

After the first point on the oblique shock wave downstream of point E has been determined, the next point on the shock wave is determined by the procedure discussed in Section III.4.C. That procedure is illustrated

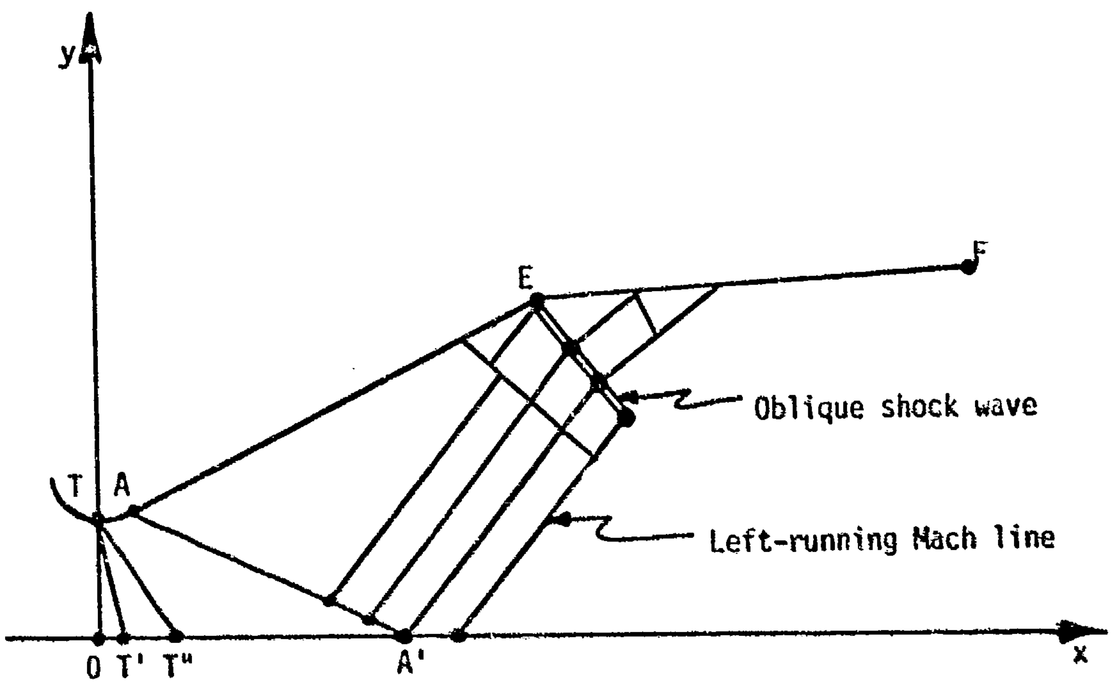
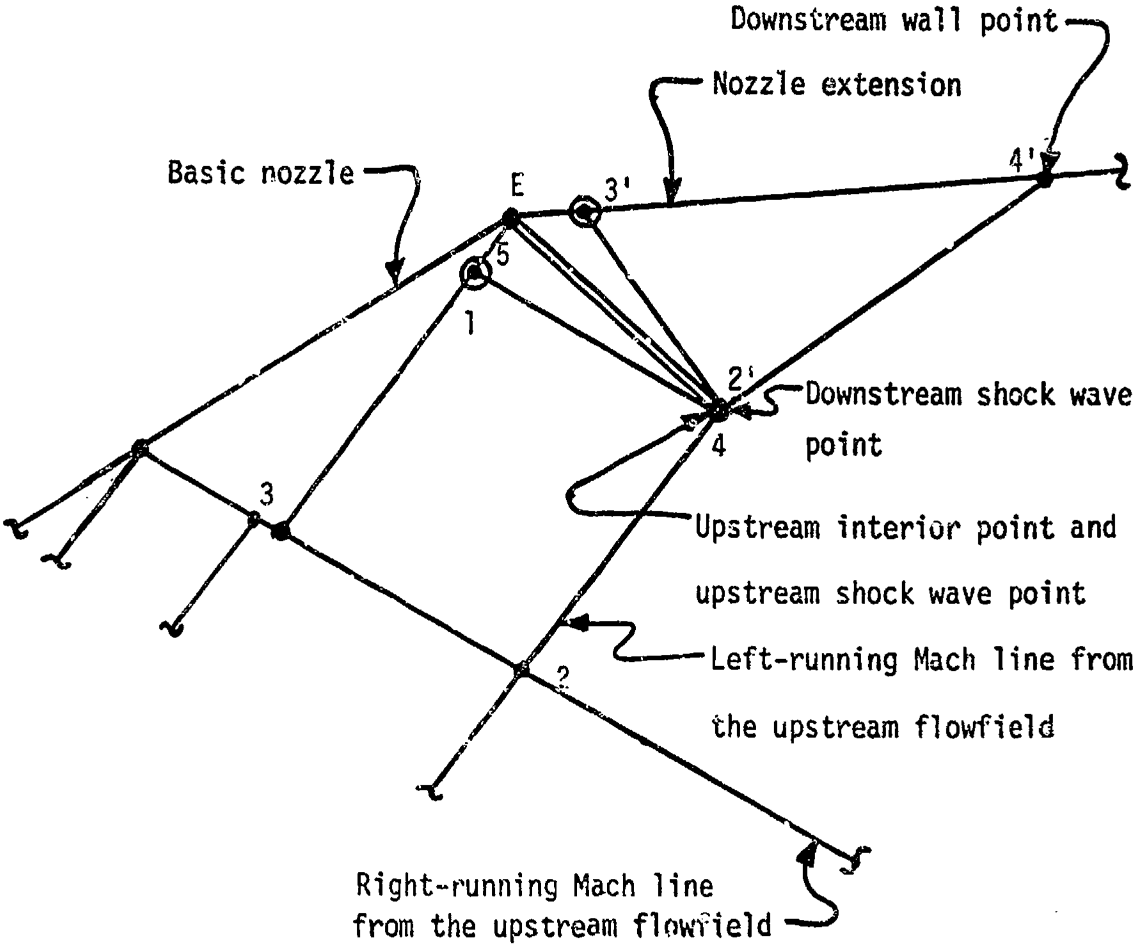


Figure 55. Propagation of a left-running Mach line from the upstream flowfield to the scarfed nozzle extension.



Known points: 2, 3, and 5

Solution points: 4, 2', and 4'

Interpolated points: 1 and 3'

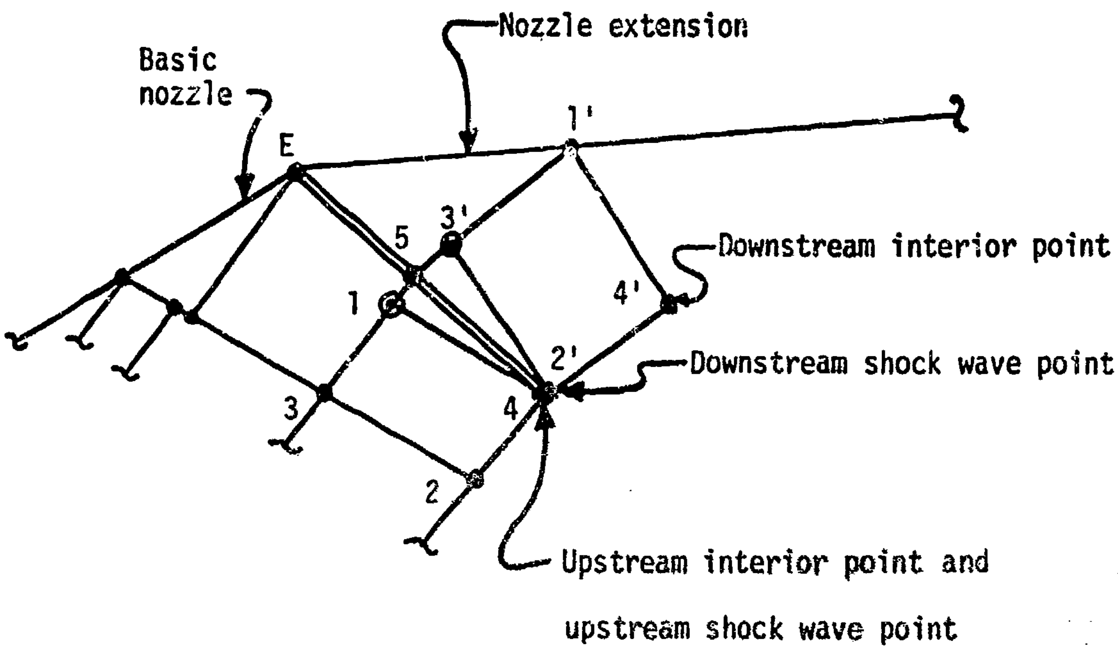
Figure 56. First point on the oblique shock wave downstream of point E.

in Figure 57. This procedure is repeated from subsequent points at the downstream extent of the upstream flowfield until the entire flowfield in the scarfed nozzle extension has been determined.

Since the strength of the oblique shock wave is greater than the strength of a Mach line, the oblique shock wave propagates at a steeper angle than the upstream right-running Mach line. Eventually the shock wave will overtake the upstream Mach line.

When the oblique shock wave overtakes the upstream right-running Mach line, that crossed right-running Mach line is simply terminated. The solution for the oblique shock wave is then obtained from the right-running Mach line preceeding the crossed right-running Mach line. The crossed right-running Mach line is then treated as a phantom right-running Mach line in the characteristic coordinate system, as discussed in Section V.10 and illustrated in Figure 53. This procedure of terminating the crossed right-running Mach line and dropping back to the previous right-running Mach line is repeated until the shock wave point is successfully located. This procedure is illustrated in Figure 58.

The right-running Mach line downstream of the oblique shock wave is steeper than the shock wave because of the compression and decelleration of the flow caused by the shock wave. Eventually the downstream Mach line will overtake the shock wave. When the downstream right-running Mach line overtakes the oblique shock wave, that downstream right-running Mach is terminated. It is then treated as a phantom right-running Mach line in the characteristic coordinate system, as discussed in Section V.10 and illustrated in Figure 53. The next solution point is then determined at the intersection of the control left-running Mach line downstream of



Known points: 1', 2, 3, and 5

Solution points: 4, 2', and 4'

Interpolated points: 1 and 3'

Figure 57. Application of the oblique shock wave point unit process.

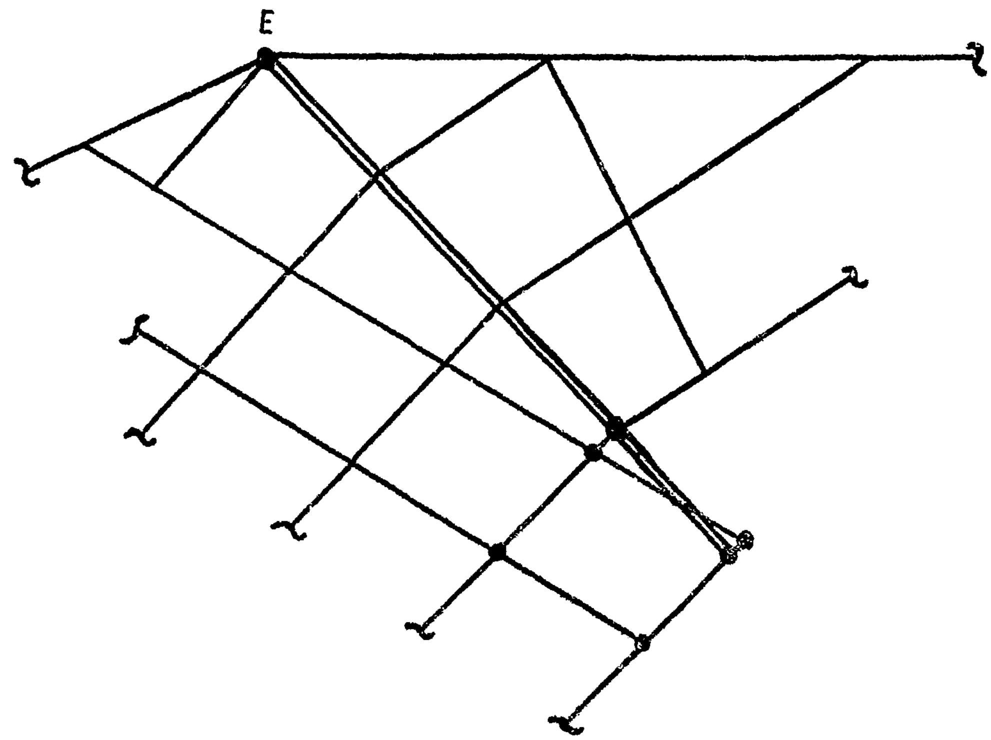


Figure 58. Oblique shock wave overtaking upstream right-running Mach line.

the terminated right-running Mach line. This procedure is illustrated in Figure 59.

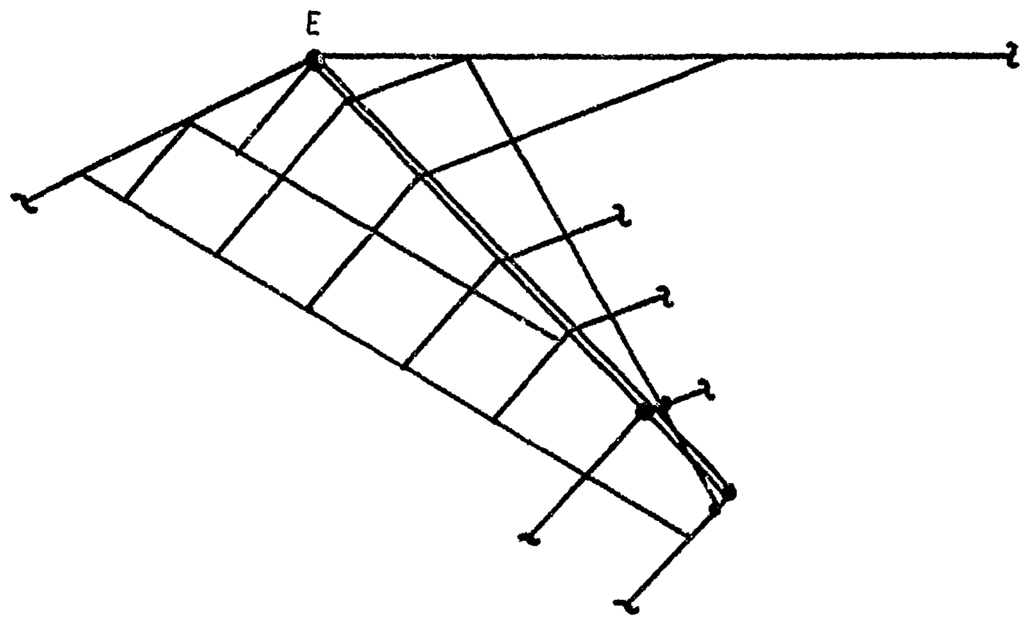


Figure 59. Downstream right-running Mach line overtaking the oblique shock wave.

12. FLOWFIELD IN THE SCARFED NOZZLE EXTENSION

The flowfield in the scarfed nozzle extension consists of the flowfield downstream of the oblique shock wave emanating from point E, the junction point of the basic nozzle and the nozzle extension. Due to the presence of an entropy gradient caused by the curved oblique shock wave, that flowfield is rotational. The flowfield model for a rotational flow is presented in Section III.5. The implementation of that procedure to determine the flowfield in the nozzle extension is described in this section.

The flowfield in the scarfed nozzle extension is determined by initiating left-running Mach lines from the upstream flowfield, as illustrated in Figure 55, and propagating those Mach lines to the scarfed nozzle extension. This procedure is repeated for succeeding left-running Mach lines until one of the three following situations arises:

1. The oblique shock wave overtakes the right-running Mach line at the downstream extent of the upstream flowfield before the end of the scarfed nozzle extension has been reached.
2. The oblique shock wave intersects the nozzle axis before the end of the scarfed nozzle extension has been reached.
3. The left-running Mach line intersects the extension of the scarfed nozzle extension beyond point F. In this case, the indirect wall point unit process is applied at point F, as illustrated in Figure 60, and the scarfed nozzle flowfield is complete. This is the normal mode of operation.

Situations (1) and (2) are illustrated in Figures 61 and 62

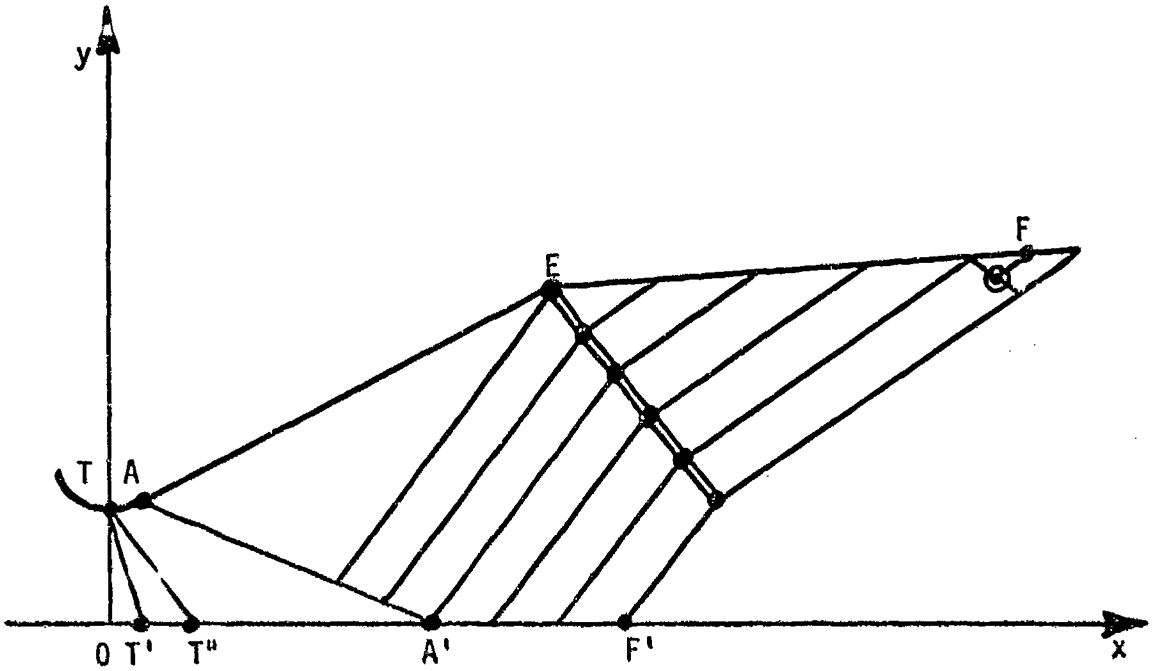


Figure 60. Normal solution for the flowfield in the nozzle extension.

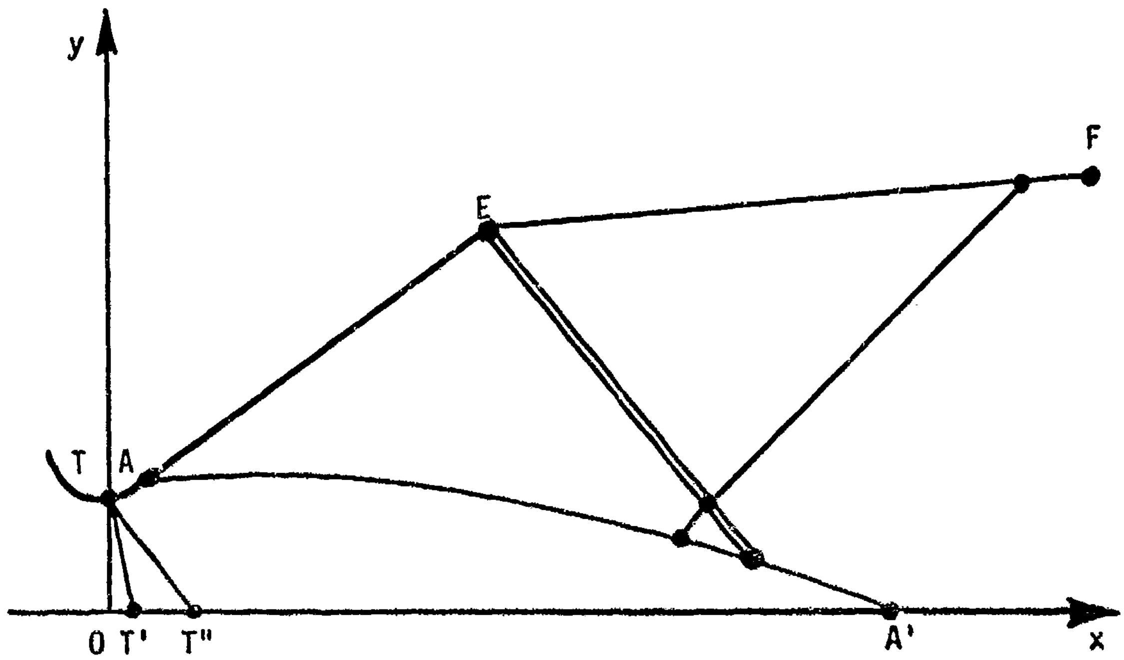


Figure 61. Oblique shock wave reaches the right-running Mach line at the upstream flowfield.

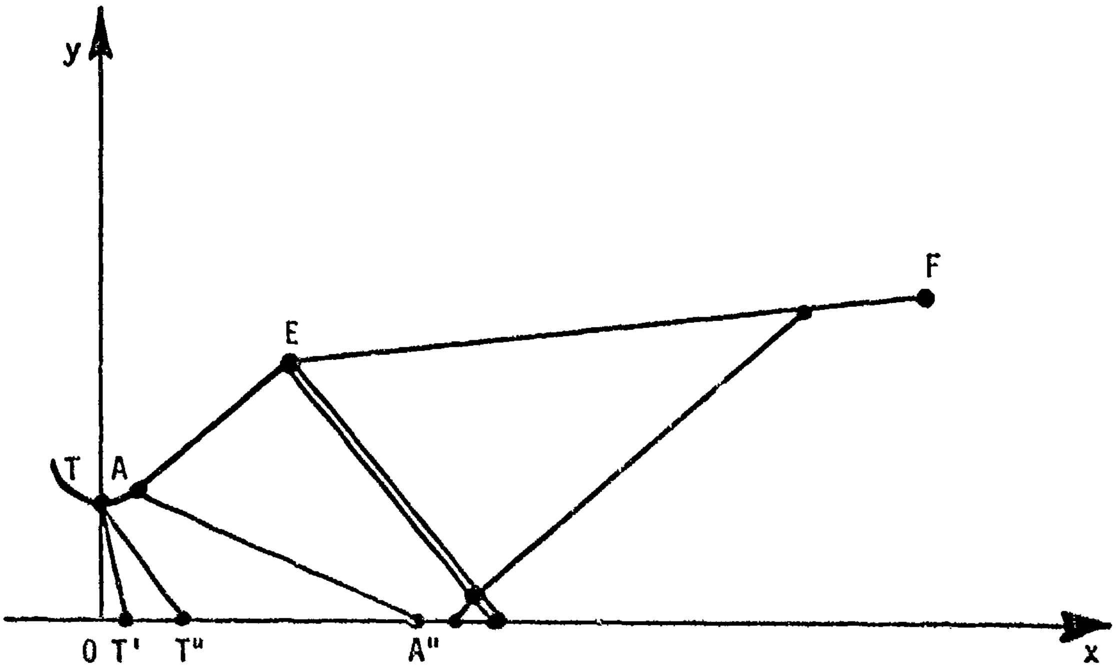


Figure 62. Oblique shock wave reaches the nozzle axis.

respectively. When the oblique shock wave reaches the nozzle axis, the calculations are terminated. In an actual flowfield, the oblique shock wave generally transitions to a Mach disc and an embedded subsonic zone in the neighborhood of the nozzle axis. That phenomena cannot be predicted by the method of characteristics. In fact, the prediction of the Mach disc and the subsonic flow region is extremely difficult, and considerably beyond the scope of the present investigation. Consequently, in the present investigation, the oblique shock wave is simply terminated at the last interior point above the nozzle axis.

Practically speaking, this situation does not arise frequently. When it does occur, the last point actually calculated is generally quite close to point F. In this situation, the approximation is made that a uniform flow exists from the last predicted wall point to point F. Since point F is at the last remnant of the scarfed nozzle extension and the pressure level in this portion of the flowfield is very nearly atmospheric in many cases, the aforementioned assumption is generally quite good. When the last calculated point is far upstream of point F and/or the internal pressure level is greatly different from atmospheric pressure, the aforementioned assumption may introduce a small but significant error into the nozzle side force, and an even smaller and probably insignificant error into the nozzle axial force. In that case, some judgement as to the accuracy of the solution must be made based on experience.

The flowfield described in Situation (1) above can sometimes be continued further by using the MODE = 5 option. That option employs a left-running Mach line network construction procedure for the flowfield along the initial expansion contour. Consequently, the oblique shock

wave can propagate all the way to the nozzle axis before the calculations must be terminated.

The implementation of the logic described in this section for determining the flowfield in the scarfed nozzle extension is contained in subroutine MOCLRCR in overlay LINK30.

13. SCARFED NOZZLE PERFORMANCE

The scarfed nozzle performance model is presented in Section IV. The application of that model is discussed in this section. The implementation of this model in the computer program is contained in overlay LINK40.

The entire flowfield in the scarfed nozzle can be calculated by the procedures presented in the preceding sections. The performance of the basic nozzle is specified in terms of the nozzle mass flow rate $\dot{m}$ and the axial thrust F_N.

Two steps are required to evaluate the performance of the scarfed nozzle extension. The first step is the calculation of the angle ψ, given by equation (121). That calculation is performed in subroutine GEOM in overlay LINK30. The second step is the calculation of the scarfed nozzle thrust components $F_{x,\ SCE}$ and $F_{y,\ SCE}$, given by equations (139) and (140). That calculation is performed in subroutine FORMOM in overlay LINK30.

The final step in the overall numerical algorithm is the calculation of the performance of the entire nozzle. That performance is specified by F_X, F_Y, $(I_{sp})_X$, $(I_{sp})_Y$, and the effective scarfing angle β_{eff}. Those parameters are defined in Section IV.4. Figure 63 illustrates the relationship between the thrust components of the scarfed nozzle and the thrust components transmitted to the missile. The calculation of the overall performance parameters is accomplished in subroutine FORMOM in overlay LINK30.

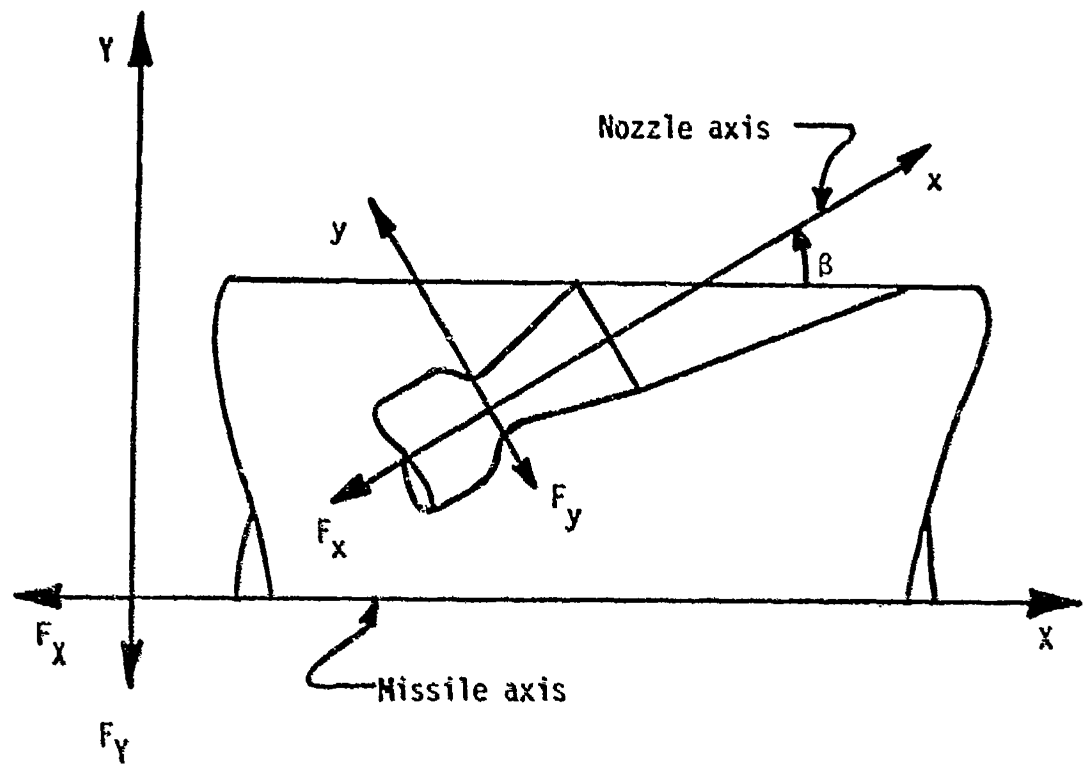


Figure 63. Overall nozzle performance model.

SECTION VI

COMPUTER PROGRAM

1. INTRODUCTION

A computer program has been developed to calculate the performance of a scarfed propulsive nozzle. A brief description of that program is presented in this section. The overlay structure of the program is described, and a brief description of the function of each program and subroutine is presented.

2. PROGRAM OVERLAY STRUCTURE

The overall program consists of 52 routines (5 program routines and 47 subroutines). The program is organized into an overlay scheme to minimize the amount of computer memory required. The overlay structure is presented in Figure 64. Two overlay levels are used: the resident overlay level and the primary overlay level.

OVERLAY (0,0) is the resident overlay which controls the overall execution of the program. Several commonly used subroutines are included in this overlay. OVERLAY (1,0) perofrms data input, parameter initialization, and generation of the initial-value line across the nozzle throat. OVERLAY (2,0) performs the evaluation of the flowfield in the basic nozzle. OVERLAY (3,0) constructs the oblique shock wave emanating from the junction between the basic nozzle and the nozzle extension and evaluates the flowfield in the nozzle extension. OVERLAY (4,0) calculates the thrust components in the scarfed extension, and determines the

LINK00			
MAIN00	BOUNDYW		
THERMOI	BOUNDYE		
THERMOR	INTERI		
OUTPUT	AXISI		
THRUST	PDATA		
FINAL	PRINT		
DWDOTR	PLOTWAL		
DWDOTL	PLOTRRC		
LINK10	LINK20	LINK30	LINK40
MAIN10	MAIN20	MAIN30	MAIN40
INPUT	MOCIVL	MOCLRCR	GEOM
IVLINE	MOCARCR	SHIFT2	FORNOM
KLIEB	MOCARCL	MOVE2	
IVLTAB	MOCRRC	POINTE	
IVLPERF	MOCLRCI	SHOCK	
COMPRES	RESET	SHOCKU	
ATTACH	SHIFT	SHOCKD	
	MOVE1	RRCHAR	
	DRWALLI	DRWALLR	
	INWALLI	INWALLR	
	POINTEE	INTERR	
		AXISR	

Figure 64. Program overlay structure.

performance of the overall scarfed propulsive nozzle.

In the following sections, a brief description is given of the function of each subroutine in the computer program. This information supplements the information available within the program in the form of comment statements.

3. OVERLAY (0,0)

MAINOO. This program routine is the main control routine in OVERLAY (0,0), the resident overlay. MAINOO first calls OVERLAY (1,0) for data input, parameter initialization, and generation of the initial-value line. MAINOO then calls OVERLAY (2,0) to calculate the flowfield in the basic nozzle, OVERLAY (3,0) to calculate the oblique shock wave and the flowfield in the nozzle extension, and OVERLAY (4,0) to calculate the nozzle performance.

THERMOI. This subroutine calculates the temperature T, pressure P, density ρ, speed of sound a, and Mach number M, corresponding to a specified value of the velocity magnitude V, for the irrotational flow of a thermally and calorically perfect gas.

THERMOR. This subroutine calculates the temperature T, speed of sound a, and Mach number M, corresponding to specified values of the pressure P, density ρ, and velocity magnitude V, for the rotational flow of a thermally and calorically perfect gas.

OUTPUT. This subroutine writes out the flow properties I, J, x, y, u, v, M, V, θ, P, ρ, T, M, $\dot{m}$, and F at a point in the flowfield.

THRUST. This subroutine calculates the increment in thrust along the wall due to the pressure forces acting on the wall, the total nozzle thrust, and the nozzle specific impulse, as described in Section IV.2. The isentropic one-dimensional values are calculated for comparison, and the nozzle performance parameters F, F_{1-D}, η_F, I_{sp}, $I_{sp,1-D}$, and η_I are written out.

DWDOTR. This subroutine calculates the increments in mass flow rate and thrust between two adjacent points on a right-running Mach line

using the trapezoidal rule.

DWDOTL. This subroutine calculates the increment in mass flow rate and thrust between two adjacent points on a left-running Mach line using the trapezoidal rule.

BOUNDYW. This subroutine contains the description of the supersonic contour of the basic nozzle (see Section II.2). The point of intersection of a left-running Mach line and the supersonic contour is located in this subroutine.

BOUNDYE. This subroutine contains the description of the nozzle extension contour (see Section II.3). The point of intersection of a left-running Mach line and the nozzle extension is located in this subroutine.

INTERI. This subroutine implements the method of characteristics solution for an interior point in an irrotational flowfield, as illustrated in Figure 27.

AXISI. This subroutine implements the method of characteristics solution for an axis point in an irrotational flowfield, as illustrated in Figure 28.

PDATA. This subroutine saves the coordinates of the points along right-running Mach lines for subsequent plotting of the right-running Mach line network.

PRINT. This subroutine prints out the data saved by subroutine PDATA.

PLOTWAL. This subroutine initializes the plotting subroutines and plots the wall contour.

PLOTRRC. This subroutine plots the right-running Mach line network, using the data saved by subroutine PDATA.

4. OVERLAY (1,0)

MAIN10. This program is the main control routine in OVERLAY (1,0). Subroutine INPUT is called to read in and write out the input data. Subroutine IVLINE is called to generate the supersonic initial-value line.

INPUT. This subroutine reads in the input data and problem specifications through namelists DATA and WALL. All of the input variables are defined by comment cards. Default values are assigned to most of the input variables before the namelists are read in. Several parameters are initialized, and the units conversion factors are specified. The program description, the job title, and the problem specifications are written out. If requested, subroutine COMPRES is called to compress the tabular wall contour.

IVLINE. This subroutine selects the type of supersonic initial-value line to be employed.

KLIEG. This subroutine internally generates a supersonic initial-value line by the perturbation analysis developed by Kliegel and Levine (2). The location (i.e., x and y coordinates) of the points on the initial-value line are specified, and the velocity components (i.e., u and v) are calculated.

IVLTAB. This subroutine reads in the coordinates (i.e., x and y), the Mach number M, and the flow angle θ along a tabular initial-value line. The velocity components (i.e., u and v) are internally calculated at each point.

IVLPERF. This subroutine calculates all of the performance parameters for the initial-value line from the specified stagnation pressure P_t and temperature T_t, the velocity components u and v, and the coordinates

x and y of the points on the initial-value line. The calculated parameters include the Mach number M, the velocity magnitude V, the flow angle θ, the static pressure P, density ρ, and temperature T, the stagnation pressure P_t and temperature T_t, the mass flow rate $\dot{m}$ flowing between each point and the nozzle axis, and the thrust associated with that mass flow rate. The nozzle overall perfomance parameters are also written out. These include the mass flow rate $\dot{m}$, the discharge coefficient C_D, the thrust F, the thrust efficiency η_F, the specific impulse I_{sp}, and the specific impulse efficiency η_I.

COMPRES. This subroutine compresses the axial coordinates of the tabular wall data.

ATTACH. This subroutine attaches the compressed tabular contour smoothly to the circular arc initial-expansion contour.

5. OVERLAY (2,0)

MAIN20. This program is the main control routine in OVERLAY (2,0). Subroutines MOCIVL, MOCARCR, MOCARCL, MOCRRC, and MOCLRCI are called to calculate the flowfield emanating from the initial-value line, the nozzle throat downstream circular arc contour, and the supersonic expansion contour.

MOCIVL. This subroutine is the control subroutine for calculating the flowfield emanating from the supersonic initial-value line. Subroutines INTERI and AXISI are called, as described in Section V.4, to calculate the flowfield. Subroutine MOVE1 is called to transfer data between computational points and storage arrays, as required. Subroutine DWDOTR is called to integrate the mass flow rate and thrust along the right-running Mach lines as they are constructed. Subroutine OUTPUT is called to write out the flow properties at each solution point.

MOCARCR. This subroutine is the control subroutine for calculating the flowfield along right-running Mach lines emanating from the throat downstream circular arc contour of the basic nozzle as described in Section V.6. Subroutines INWALLI, INTERI, and AXISI are called to calculate the flowfield. Subroutine MOVE1 is called to transfer data between computational points and solution arrays, as required. Subroutine THRUST is called to integrate the thrust generated along the nozzle wall, as described in Section IV.2. Subroutine DWDOTR is called to integrate the mass flow rate and thrust along the right-running Mach lines as they are constructed. Subroutine OUTPUT is called to write out the flow properties at each solution point.

MOCARCL. This subroutine is the control subroutine for calculating the flowfield along left-running Mach lines along the initial expansion contour of the basic nozzle, described in Section V.8. Subroutines INWALLI, INTERI, and AXISI are called to calculate the flowfield. Subroutine MOVE1 is called to transfer data between computational points and solution arrays, as required. Subroutine THRUST is called to integrate the thrust generated along the nozzle wall, as described in Section IV.2. Subroutine DWDOTL is called to integrate the mass flow rate and thrust along the left-running Mach lines as they are constructed. Subroutine OUTPUT is called to write out the flow properties at each solution point.

MOCRRC. This subroutine is the control subroutine for calculating the flowfield along right-running Mach lines emanating from the supersonic contour of the basic nozzle as described in Section V.9. Subroutines DRWALLI, INTERI, and AXISI are called to calculate the flowfield. Subroutine MOVE1 is called to transfer data between computational points and solution arrays, as required. Subroutine THRUST is called to integrate the thrust generated along the nozzle wall, as described in Section IV.2. Subroutine DWDOTR is called to integrate the mass flow rate and thrust along the right-running Mach lines as they are constructed. Subroutine OUTPUT is called to write out the flow properties at each solution point.

MOCLRCI. This subroutine is the control subroutine for calculating the flowfield along left-running Mach lines that intersect the supersonic contour of the basic nozzle, as described in Section V.10. Subroutines DRWALLI, INTERI, and AXISI are called to calculate the flowfield.

Subroutine MOVE1 is called to transfer data between computational points and solution arrays, as required. Subroutine THRUST is called to integrate the thrust generated along the nozzle wall, as described in Section IV.2. Subroutine DWDOTL is called to integrate the mass flow rate and thrust along the left-running Mach lines as they are constructed. Subroutine OUTPUT is called to write out the flow properties at each solution point.

RESET. This subroutine resets points along a right-running Mach line after it crosses the previous right-running Mach line, so that the remaining points to be calculated are defined to be the remaining points on the previous right-running Mach line, as illustrated in Figure 39.

SHIFT. This subroutine resets points along a left-running Mach line after it crosses the previous left-running Mach line, so that the remaining points to be calculated are the remaining points on the previous left-running Mach line, as illustrated in Figure 44.

MOVE1. This subroutine transfers data between grid points (points 1 to 4) and the storage arrays [X(150), Y(150), etc.] as requested by the logic control subroutines (MOCIVL, MOCARCR, MOCARCL, MOCRRC, and MOCLRCI).

DRWALLI. This subroutine implements the method of characteristics solution for a direct wall point in an irrotational flowfield, as illustrated in Figure 37.

INWALLI. This subroutine implements the method of characteristics solution for an inverse wall point in an irrotational flowfield, as illustated in Figures 31 and 32.

POINTEE. This subroutine defines the properties at the beginning of an embedded shock wave at point (IE, JE) in the characteristic coordinate system. This feature is used in MODE = 3 and only in MODE = 3.

6. OVERLAY (3,0)

MAIN30. This program is the main control program for OVERLAY (3,0), which calculates the rotational flowfield downstream of the oblique shock wave. Subroutine MOCLRCL is called to control the logic for calculating the flowfield. If an attached oblique shock wave exists at point E (MODE = 4 or 5), subroutine POINTE is called first to determine the properties at the shock wave at point E.

MOCLRCR. This subroutine contains the logic for constructing the oblique shock wave emanating from the junction of the basic nozzle and the nozzle extension (see Section V.11). Subroutine POINTE is called to determine the properties of the oblique shock wave at point E itself. Then subroutines INTERI, SHOCK, INTERR, and DRWALLR are called in sequence to determine the solution for an oblique shock wave point, as illustrated in Figure 48. Subroutine THRUST is called to calculate the thrust at the wall points. Subroutine MOVE2 is called to transfer data between computational points and storage arrays, as required. Subroutine DWDOTL is called to integrate the mass flow rate and thrust along the left-running Mach lines as they are constructed. Subroutine OUTPUT is called to write out the flow properties at each solution point. When the shock wave reaches the downstream extent of the upstream flowfield, as illustrated in Figure 53 or 54, the solution is terminated and the properties at the exit of the scarfed nozzle extension are extrapolated.

SHIFT2. This subroutine resets points along a left-running Mach line after it crosses the previous left-running Mach line, so that the remaining points to be calculated are the remaining points on the previous

left-running Mach line, as illustrated in Figure 44.

MOVE2. This subroutine transfers data between grid points (points 1 to 5) and the storage arrays [X(150), Y(150), etc.] as required by the logic control subroutine MOCLRCR and the other computational subroutines.

POINTE. This subroutine calculates the properties of the downstream side of the oblique shock wave at point E, as described in Section V.11.

SHOCK. This subroutine controls the logic for calculating the solution at a shock wave point, as discussed in Section V.11.

SHOCKU. This subroutine calculates the properties on the upstream side of the oblique shock wave as discussed in Section V.11 and illustrated in Figures 49 and 50.

SHOCKD. This subroutine calculates the properties on the downstream side of the oblique shock wave as discussed in Section V.11 and illustrated in Figures 49 and 50.

RRCHAR. This subroutine applies the compatibility relation along a rearward projected right-running Mach line from the downstream side of the oblique shock wave to check for overall convergence of the oblique shock wave calculation procedure. This procedure is described in Section V.11 and illustrated schematically in Figures 49 and 50.

DRWALLR. This subroutine implements the method of characteristics solution for a direct wall point in a rotational flowfield, as illustrated schematically in Figure 48.

INWALLR. This subroutine implements the method of characteristics solution for an inverse wall point in a rotational flowfield, as discussed in Section V.12 and illustrated schematically in Figure

INTERRR. This subroutine implements the method of characteristics solution for an interior point in a rotational flowfield, as discussed in Section V.12 and illustrated schematically in Figure 57.

AXISR. This subroutine implements the method of characteristics solution for an axis point in a rotational flowfield. In the present program, right-running Mach lines from the nozzle extension never reach the nozzle axis, as discussed in Section V.11 and illustrated schematically in Figures 53 and 54. Consequently, subroutine AXISR is not called in the present program.

7. OVERLAY (4,0)

MAIN40. This program is the main control program in OVERLAY (4,0). The purpose of OVERLAY (4,0) is to implement the calculation of the scarfed nozzle performance, as discussed in Section V.13. MAIN40 calls subroutine GEOM to calculate the angle ψ, given by equation (121). Subroutine FORMOM is called to calculate the performance of the scarfed nozzle and the missile performance.

GEOM. This subroutine calculates the angle ψ, given by equation (121).

FORMOM. This subroutine calculates the performance of the scarfed nozzle and the overall missile performance, as discussed in Section V.13.

SECTION VII

INPUT PARAMETERS

1. INTRODUCTION

The problem specifications are defined by input parameters which are read in by namelists DATA and WALL in subroutine INPUT and by namelist IVSL in subroutine IVLTAB, all in OVERLAY (1,0). Only those parameters that are pertinent for a particular problem need be read in. Many parameters have default values, and need not be specified unless values different from the default values are to be considered. All of the input parameters are discussed in this section. Where appropriate, default values are specified. The default values specify Sample Case No. 1.

2. TITLE CARD

The first card of each data deck is a title card consisting of 80 alphanumeric characters of identifying information. This card may be blank, or contain any combination of allowable FORTRAN characters. This card must be the first card of every data deck, even if the card is blank. The format of the card is (8A10).

3. NAMELIST DATA

The parameters specified by namelist DATA are described in this section. All of these parameters have default values, which are reset to their original values before each data case. The first 14 parameters (IUNITS to NWRITE) are logic control parameters. The next two parameters (G and RG) specify the gas thermodynamic model. The following three parameters (PS, TS, and PA) define the nozzle operating conditions. The next ten parameters (DELTA to XMAX) specify the geometry of the basic nozzle. The following three parameters (AF, XF, and BETA) specify the geometry of the scarfed conical extension. The next two parameters (DYRATIO and DARATIO) are used to refine the spacing of the characteristic network. The final five parameters (ICORI to IDUMP) are convergence control parameters and dump flags.

There are actually eight more parameters included in namelist DATA. These are ICMP, IPLOT, ICPLOT, YMAX, XDES, YDES, IE, and JE. These parameters are not used in the analysis of a conventional nozzle (MODE = 1 or 2) or in the analysis of a scarfed nozzle (MODE = 4 or 5). They are used in the analysis of a compressed nozzle with an embedded right-running oblique shock wave. Those eight parameters are not described in this report.

IUNITS A positive integer variable denoting the unit system employed in the analysis.

IUNITS	Unit system
1	English engineering (EE) units
2	System International (SI) units

The default value of IUNITS is 1.

MODE A positive integer variable denoting the type of analysis to be performed.

MODE	Type of analysis to be performed
0	Transonic initial-value line only
1	Conventional nozzle following right-running Mach lines
2	Conventional nozzle following left-running Mach lines
3	Conventional nozzle with an embedded RR shock wave
4	Scarfed nozzle following RRCS and LRCS
5	Scarfed nozzle following LRCS

The default value of MØDE is 4.

IWALL A positive integer variable denoting the type of basic nozzle contour to be analyzed.

IWALL	Type of basic nozzle contour
1	Conical contour
2	Quadratic contour
5	Tabular contour read in from TAPE5
8	Tabular contour read in from TAPE8

The default value of IWALL is 1.

JWALL A positive integer variable which controls punching out the basic nozzle contour.

JWALL	Basic nozzle contour punch option
0	Don't punch
1	Do punch

The default value of JWALL is 0.

NI A positive integer variable denoting the number of points on the initial-value line across the nozzle throat. The default value of NI is 11.

NT A positive integer variable denoting the number of indirect wall points on the nozzle throat downstream circular arc contour. The default value of NT is 15.

IVS A positive integer variable denoting the type of initial-value line to be employed.

IVS	Type of initial-value line
1	Kliegel's analysis (internally generated)
5	Tabular data read in from TAPE5
7	Tabular data read in from TAPE7

The default value of IVS is 1.

IOUT A positive integer variable which controls the width of the output.

IOUT	Width of output
0	80 column output
1	132 column output

IWRITE A positive integer variable specifying the right-running characteristic on which KWRITE is set to 2. The default value of IWRITE is 0.

JWRITE A positive integer variable specifying the left-running characteristic on which KWRITE is set equal to 2. The default value of JWRITE is 0.

KWRITE A positive integer variable which controls the amount of flow-field output.

KWRITE	Output option
1	Write out only first and last points on each Mach line
2	Write out all points on each Mach line, including deleted points.
3	Write out all points on each Mach line, excluding deleted points
4	Write out only the first, second, and last pages

The default value of KWRITE is 1.

LWRITE A positive integer variable specifying the right-running characteristic at which all of the 10 dump flags IDUMP(I) are set equal to 1. The default value of LWRITE is 0.

MWRITE A positive integer variable specifying the left-running characteristic at which all 10 dump flags IDUMP(I) are set equal to 1. The default value of MWRITE is 0.

G The gas specific heat ratio γ (dimensionless). The default value of G is 1.2.

RG The gas constant R (ft-lbf/lbm-R or kJ/kg-K). The default value of RG is 65.0.

PS The nozzle inlet stagnation pressure P_t (lbf/in.^{2} or N/m^2). The default value of PS is 1000.0.

TS The nozzle inlet stagnation temperature T_t (R or K). The default value of TS is 5000.0.

PA The ambient (i.e., atmospheric) pressure P_a (lbf/in.^{2} or N/m^2). The default value of PA is 14.696.

The nozzle geometric model is illustrated in Figure 65. The nozzle throat consists of a double circular arc contour. The supersonic contour of the basic nozzle attaches smoothly to the throat downstream circular arc contour (i.e., at point A, y_a and θ_a for the circular arc and the supersonic contour are the same). The length of the basic nozzle is x_e.

The basic nozzle contour may be conical (IWALL = 1). The conical contour may be specified by any of the following five sets of parameters.

1. The throat attachment angle θ_a and the nozzle length x_e.
2. The throat attachment angle θ_a and the exit lip radius y_e.
3. The throat attachment angle θ_a and the nozzle area ratio ε.
4. The nozzle legth x_e and exit lip radius y_e.
5. The nozzle length x_e and nozzle area ratio ε.

The basic nozzle contour may be a quadratic (IWALL = 2). The quadratic contour may be specified by any of the following three sets of parameters.

1. The throat attachment angle θ_a, the exit lip angle θ_e, and the nozzle length x_e.
2. The throat attachment angle θ_a, the nozzle length x_e, and the exit lip radius y_e.
3. The throat attachment angle θ_a, the nozzle length x_e, and the nozzle area ratio ε.

The default values of all these parameters are 0.0. The desired option is selected simply by specifying nonzero values for the appropriate variables. The remaining variables are internally calculated

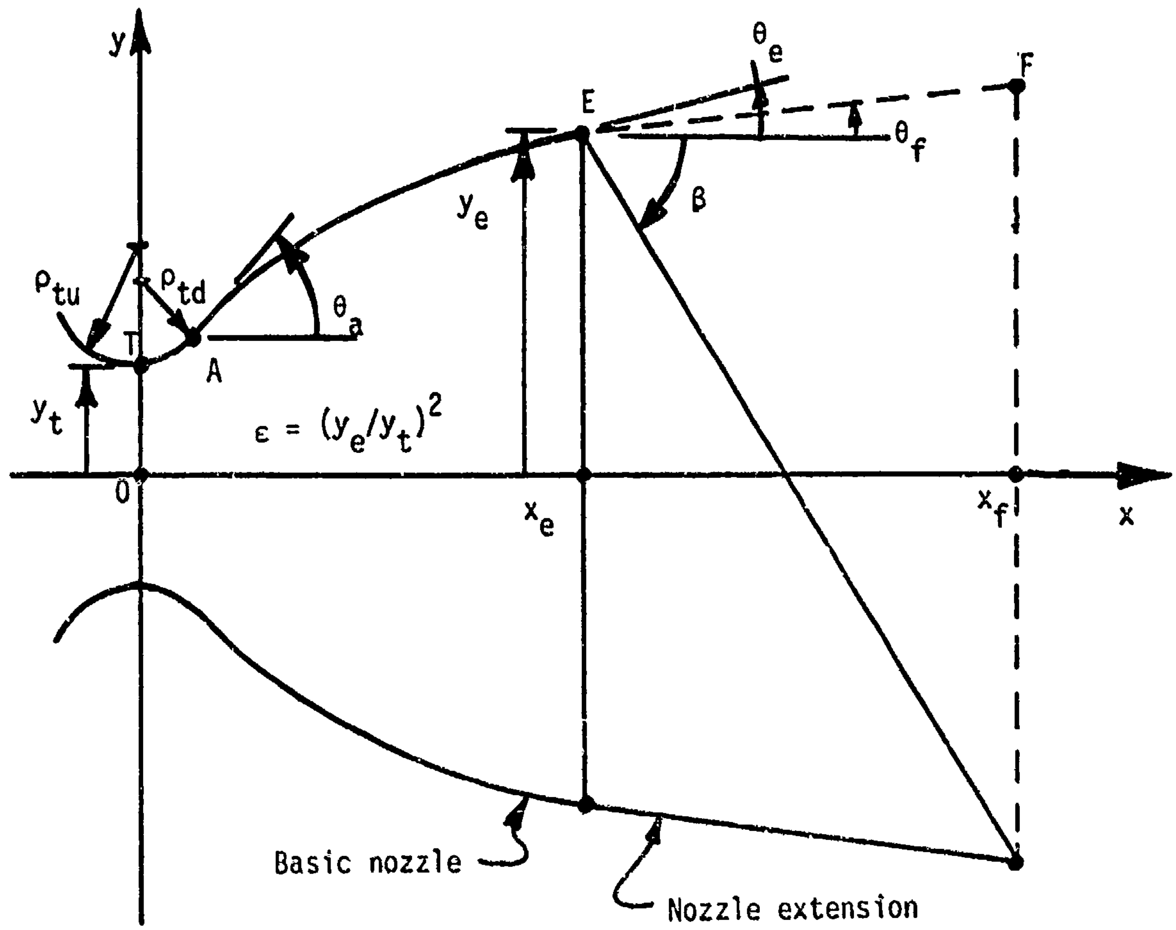


Figure 65. Nozzle geometric model.

from those specified.

The remaining option for specifying the supersonic contour of the basic nozzle, the tabular wall option, is discussed in Section VII.4.

The conical extension is completely specified by the cone angle θ_f and the x coordinate of the end of the extension, x_f. The conical extension is attached to the basic nozzle at point E.

DELTA A real variable denoting the type of coordinate system to be considered.

DELTA	Coordinate system
0.0	Two-dimensional planar
1.0	Two-dimensional axisymmetric

The default value of DELTA is 1.0.

YT The nozzle throat radius y_t (in. or m). The default value of YT is 1.0.

RTU The nozzle throat upstream circular arc radius of curvature ρ_{tu} (in. or m). The default value of RTU is 1.0.

RTD The nozzle throat downstream circular arc radius of curvature ρ_{td} (in. or m). The default value of RTD is 0.01.

AA The nozzle throat attachment angle θ_a (deg). The default value of AA is 0.0.

AE The basic nozzle exit lip angle at point E, θ_e (deg). The default value of AE is 0.0.

EPS The basic nozzle area ratio $\varepsilon = (y_e/y_t)^2$ (dimensionless). The default value of EPS is 0.0.

YE The basic nozzle exit lip radius y_e (in. or m). The default

value of YE is 0.0.

XE The x coordinate of the length of the basic nozzle x_e (in. or m). The default value of XE is 0.0.

XMAX A real variable denoting the x location at which right-running Mach lines may be terminated to save computational effort when the flowfield beyond the end of the nozzle is not required, as illustrated in Figure 66. XMAX is only used when analyzing a basic nozzle following right-running Mach lines (MODE = 1). In that case, XMAX must be at least as large as XE, the length of the basic nozzle. For the analysis of scarfed nozzles (MODE = 4 or 5), XMAX must be a large number so that the entire flowfield from the basic nozzle is obtained. The default value of XMAX is 1000.0.

The conical nozzle extension is also illustrated in Figure 65. The conical extension may be specified by either of the following options.

1. The cone angle θ_f and the x coordinate of the end of the conical extension x_f.
2. The cone angle θ_f and the nozzle scarfing angle β.

The default values of x_f and β are both 0.0. The desired option is selected by simply specifying a nonzero value for either x_f or β. The other variable is internally computed from the one specified.

AF The conical extension wall angle θ_f (deg). The default value of AF is 0.0.

XF The x coordinate of the end of the conical extension x_f (in. or m). The default value of XF is 0.0.

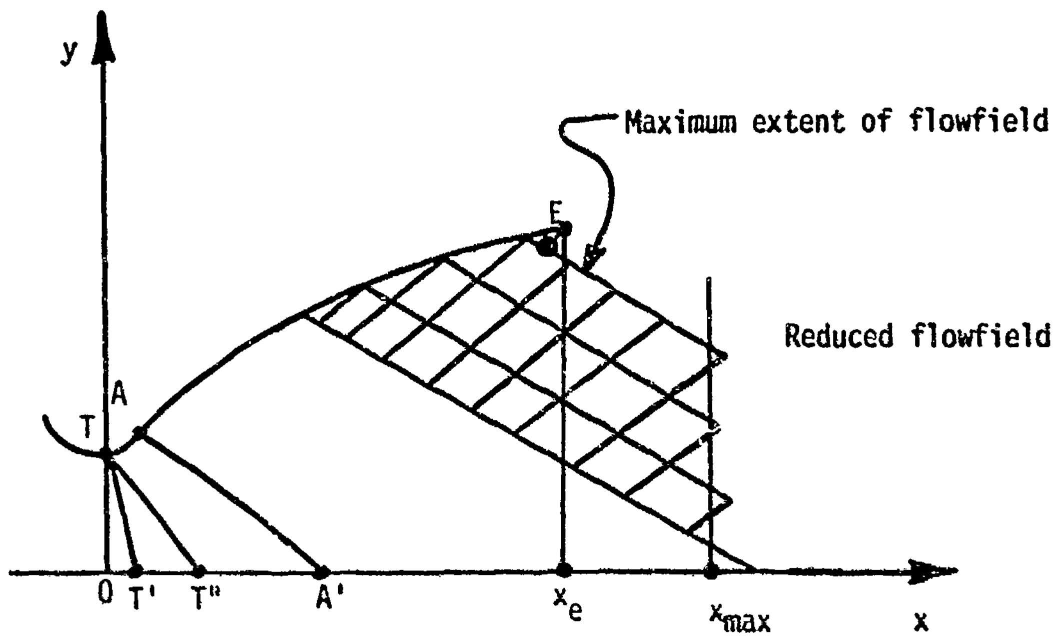


Figure 66. Definition of the variable x_{max}.

BETA The nozzle scarfing angle. The default value of BETA is 0.0.

The next two variables, DYRATIO and DARATIO, are used to refine the spacing of the characteristic network. DYRATIO is discussed in Section V.3, and DARATIO is discussed in Section V.5.

DYRATIO A real variable specifying the ratio of the final Δy on the initial-value line adjacent to the nozzle wall to the initial Δy adjacent to the nozzle axis (dimensionless). The default value of DYRATIO is 1.0.

DARATIO A real variable specifying the ratio of the final $\Delta\theta$ on the nozzle throat downstream circular arc adjacent to the throat attachment point, point A in Figure 37, to the initial $\Delta\theta$ adjacent to the nozzle throat, point T in Figure 37 (dimensionless). The default value of DARATIO is 1.0.

The remaining five parameters are convergence control parameters and dump flags.

ICOR A positive integer variable specifying the number of applications of the corrector in the modified-Euler predictor-corrector numerical solution of the characteristic equations and compatibility relations. ICOR = 0 yields the Euler predictor method, ICOR = 1 yields the modified-Euler predictor-corrector method, and ICOR $\geq$ 2 yields the modified-Euler predictor-corrector method with (ICOR - 1) iterations. The default value of ICOR is 2.

E1 A positive real variable denoting the tolerance (in. or m) for location convergence in the numerical method of characteristics calculations. The default value of E1 is 0.0, causing the unit process calculations to terminate after ICOR applications of the

integration algorithm.

E2 A positive real variable denoting the fractional convergence tolerance (dimensionless) for flow property convergence in the numerical method of characteristics. The default value of E2 is 0.0, causing the unit process calculations to terminate after ICOR applications of the integration algorithm.

IDUMP A one-dimensional integer variable array dimensioned at 10. Each element of IDUMP activates output dumps of selected parameters during the flowfield calculations for use in debugging problems. A value of 0 suppresses the dumps, and a value of 1 activates the dumps. The default values of all 10 elements of IDUMP are 0.

IDUMP (I)	Subroutines with dumps activated
1	MOCLRCI, MAIN30, MOCLRCR
2	RESET, SHIFT, SHIFT2
3	POINTEE, POINTE, SHOCK, SHOCKU, SHOCKD
4	COMPRES, ATTACH
5	RRCHAR
6	BOUNDYW, BOUNDYE, DRWALLI, DRWALLR
7	INTERI, INTERR
8	INWALLI, INWALLR
9	AXISI, AXISR
10	not used

This completes the specification of all of the input data read in by namelist DATA.

4. NAMELIST WALL

The parameters specified by namelist WALL are described in this section. These parameters specify the tabular wall contour option (IWALL = 5 or 8 in namelist DATA) for the basic nozzle. For the analytical wall options (IWALL = 1 or 2), this namelist should be omitted from the data deck. The tabular nozzle option is discussed in Section II.3.d.

The tabular nozzle geometry is illustrated in Figure 67. The wall table, when complete, will have NWALL pairs of x and y coordinates in the arrays XW and YW, respectively. The first point in the table will be the throat attachment point, point A. The coordinates of point A (i.e., x_a and y_a) are calculated internally and stored in XW(1) and YW(1). Consequently, the values of ρ_{td} and θ_a (i.e., RTD and AA) in namelist DATA must be specified. The remaining wall points are read in through namelist WALL. The first input point is XW(2) and YW(2). The succeeding points follow in order. The last point specified in the tabular data is defined internally to be point E (i.e., x_e and y_e). The number of points actually read in through namelist WALL is denoted by NWALL. The total number of points in the wall table is NWALL + 1, due to the insertion of point A as the first point in the table. The input value of NWALL is increased by one internal to the program to reflect the total number of points in the wall table. The computer program locally fits a quadratic polynomial to the tabular data when calculating the intersection point of a left-running Mach line and the tabular nozzle wall.

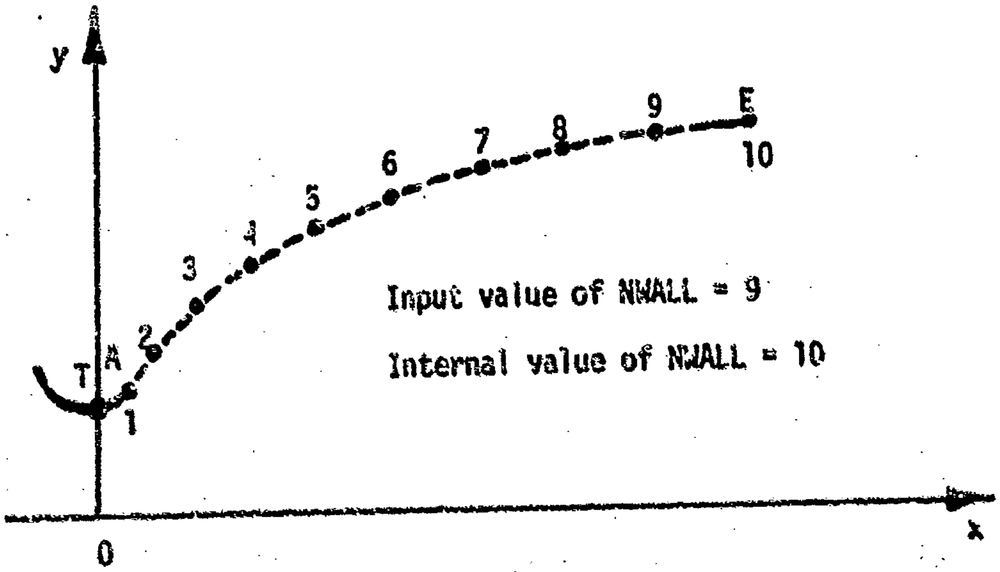


Figure 67. Tabular nozzle geometry.

NWALL An integer variable specifying the number of points in the tabular wall table (must be 99 or less). No default value is specified for NWALL.

XW A one-dimensional real variable array dimensioned at 99. XW(I) (I = 1, NWALL) denotes the axial location (in. or m) of the Ith tabular wall point. No default values are specified for XW(I).

YW A one-dimensional real variable array dimensioned at 99. YW(I) (I = 1, NWALL) denotes the radial location (in. or m) of the Ith tabular wall point. No default values are specified for YW(I).

5. NAMELIST IVSL

The parameters specified by namelist IVSL are described in this section. These parameters specify the tabular initial-value line option (IVS = 5 or 7 in namelist DATA). For the internally generated initial-value line option (IVS = 1), this namelist should be omitted from the data deck. The tabular initial-value line option is discussed in Section V.3.B.

The tabular initial-value line is illustrated in Figure 68. The first point on the tabular initial-value line must be the nozzle axis point, and the last point must be the nozzle throat point, point T. The number of points NI (specified in namelist DATA) and their spacing is arbitrary. The maximum number of tabular initial-value line points is 30.

XIV A one-dimensional real variable array dimensioned at 30. XIV(I) (I = 1, NI) denotes the axial location (in. or m) of the Ith tabular initial-value line point. No default values are specified for XIV(I).

RIV A one-dimensional real variable array dimensioned at 30. RIV(I) (I = 1, NI) denotes the radial location (in. or m) of the Ith tabular initial-value line point. No default values are specified for RIV(I).

MIV A one-dimensional real variable array dimensioned at 30. MIV(I) (I = 1, NI) denotes the Mach number (dimensionless) at the Ith point on the tabular initial-value line. No default values are specified for MIV(I).

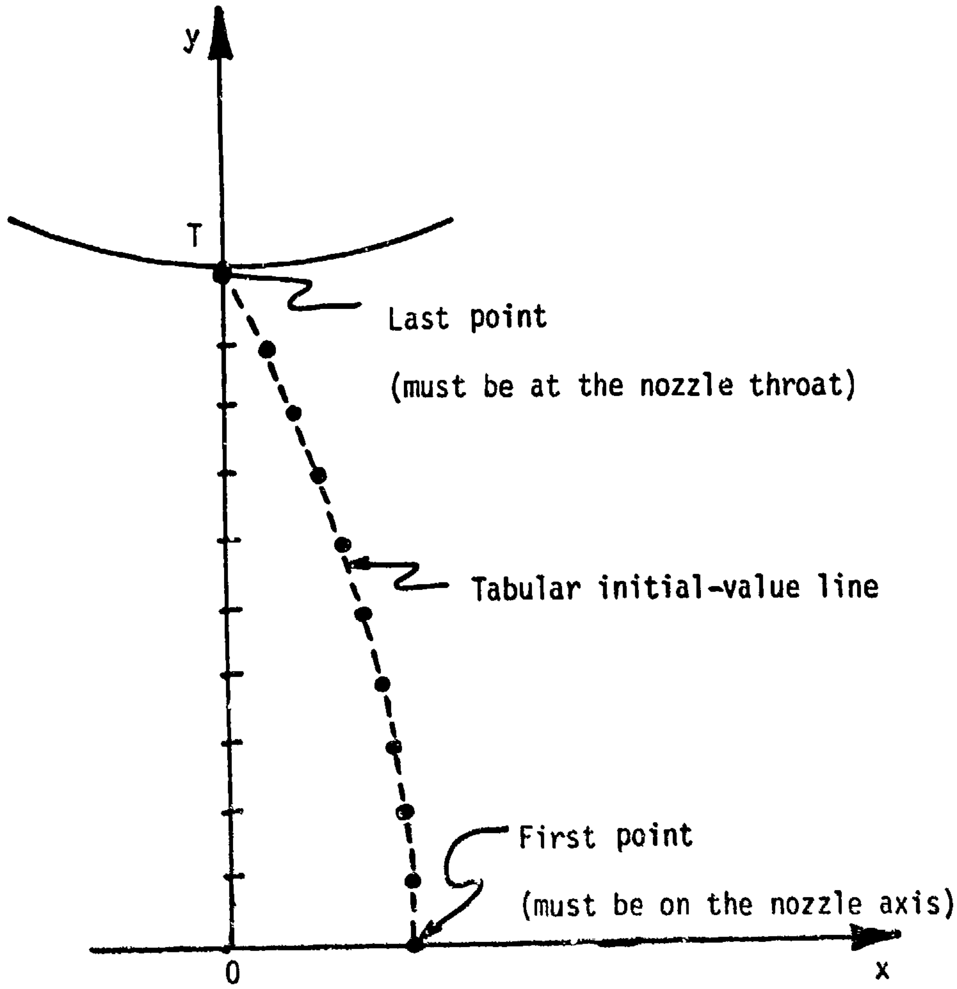


Figure 68. Tabular initial-value line.

TIV A one-dimensional real variable array dimensioned at 30. TIV(I) (I = 1, NI) denotes the flow angle (deg) at the Ith point on the tabular initial-value line. No default values are specified for TIV(I).

SECTION VIII

SAMPLE CASES

1. INTRODUCTION

Fifteen sample cases are presented in this section to illustrate the application of the computer program for calculating the flowfield in scarfed propulsive nozzles. For each sample case, a discussion of the problem is presented, the input data are discussed, and the data deck required to execute the program is presented. Selected portions of the computer output are presented for some of the sample cases.

The first eight sample cases are all concerned with the same scarfed nozzle configuration. That nozzle consists of a conical nozzle and a cylindrical extension. The nominal case is specified by a nozzle cone angle $\theta_a = 15$ deg, a nozzle area ratio $\varepsilon = 10$, a cylindrical extension with $\theta_f = 0$ deg, and a scarf angle $\beta = 30$ deg.

Sample Case No. 1 includes a complete discussion of the problem and the input data for the case in which the conical contour is specified by the cone angle θ_a and the area ratio ε. Sample Cases No. 2 to 4 are identical to Sample Case No. 1, except that the conical contour is specified by the exit lip radius y_e, the nozzle length x_e, and tabular data, respectively. Sample Case No. 5 illustrates the tabular initial-value line option. Sample Case No. 6 illustrates an optional Mach line network construction feature. Sample Case No. 7 illustrates the variable initial-value line spacing option and the variable inverse wall

point spacing option on the nozzle throat downstream circular arc.

Sample Case No. 8 is the same as Sample Case No. 1, except that the length x_f of the conical extension is specified instead of the scarf angle β. Sample Case No. 9 has the same nozzle as Sample Case No. 1, but the scarfed nozzle extension is a cone with $\theta_f = 5$ deg.

Sample Cases No. 10 to 12 illustrate various options for analyzing a simple conical nozzle without an extension. Sample Case No. 10 considers the nominal case modified by specifying the angle θ_f of the conical extension to be the same as the nozzle cone angle θ_a. Sample Case No. 11 analyzes the combined nozzle and extension considered in Sample Case No. 10 as a single conical nozzle without an extension. Sample Case No. 12 illustrates an optional Mach line network construction feature for a single nozzle. This same feature is illustrated in Sample Case No. 6 for the nominal case with a cylindrical extension.

Sample Cases No. 13 to 15 are all concerned with the same scarfed nozzle configuration. That nozzle consists of a quadratic nozzle contour and a cylindrical nozzle extension. Sample Case No. 13 is the nominal case for the quadratic nozzle contour. The nominal case is specified by a throat attachment angle $\theta_a = 25$ deg, an area ratio $\epsilon = 10$, and a nozzle length $x_e = 8.07104661$. The scarfed nozzle extension is cylindrical and the scarf angle $\beta = 30$ deg. This nozzle has the identical envelope as the conical nozzle nominal case, Sample Case No. 1. Sample Cases No. 14 and 15 are identical to Sample Case No. 13, except that the quadratic nozzle contour is specified by the nozzle exit lip radius y_e and the nozzle exit lip angle θ_e, respectively.

2. SAMPLE CASE NO. 1

This sample case is the basic problem considered in all of the sample cases. The nozzle to be analyzed is a conical nozzle having a scarfed cylindrical extension as illustrated in Figure 69. The English Engineering (EE) system of units is employed in all of the sample cases (IUNITS = 1). The problem to be considered is the analysis of a scarfed propulsive nozzle (MODE = 4). The basic nozzle is a conical nozzle (IWALL = 1). Punched output of the wall contour is not desired (JWALL = 0). Eleven equally spaced points are desired on the initial-value line (NI = 11 and DYRATIO = 1.0), and 15 equally spaced points are desired on the nozzle throat downstream circular arc (NT = 15 and DARATIO = 1.0). The initial-value line is to be generated internally by Kliegel's method (IVS = 1). Every point on each Mach line is to be written out (KWRITE = 2), and KWRITE is to remain at the value of 2 for the entire calculation (IWRITE = JWRITE = 0).

The gas specific heat ratio γ is 1.2 (GAMMA = 1.2) and the gas constant R is 65.0 (ft-lbf)/(lbm-R).

The nozzle inlet stagnation pressure P_t and temperature T_t are 1000.0 lbf/in.^{2} and 5000.0 R, respectively (PS = 1000.0 and TS = 5000.0). The ambient pressure P_a is 14.696 lbf/in.^{2} (PA = 14.696).

The nozzle is axisymmetric (DELTA = 1.0). The throat radius y_t is 1.0 in. (YT = 1.0), the nozzle throat upstream radius of curvature ρ_{tu} is 1.0 in. (RTU = 1.0), and the nozzle throat downstream radius of curvature ρ_{td} is 0.01 in. (RTD = 0.01). The basic nozzle contour is conical (IWALL = 1), and the conical geometry is specified by the nozzle throat

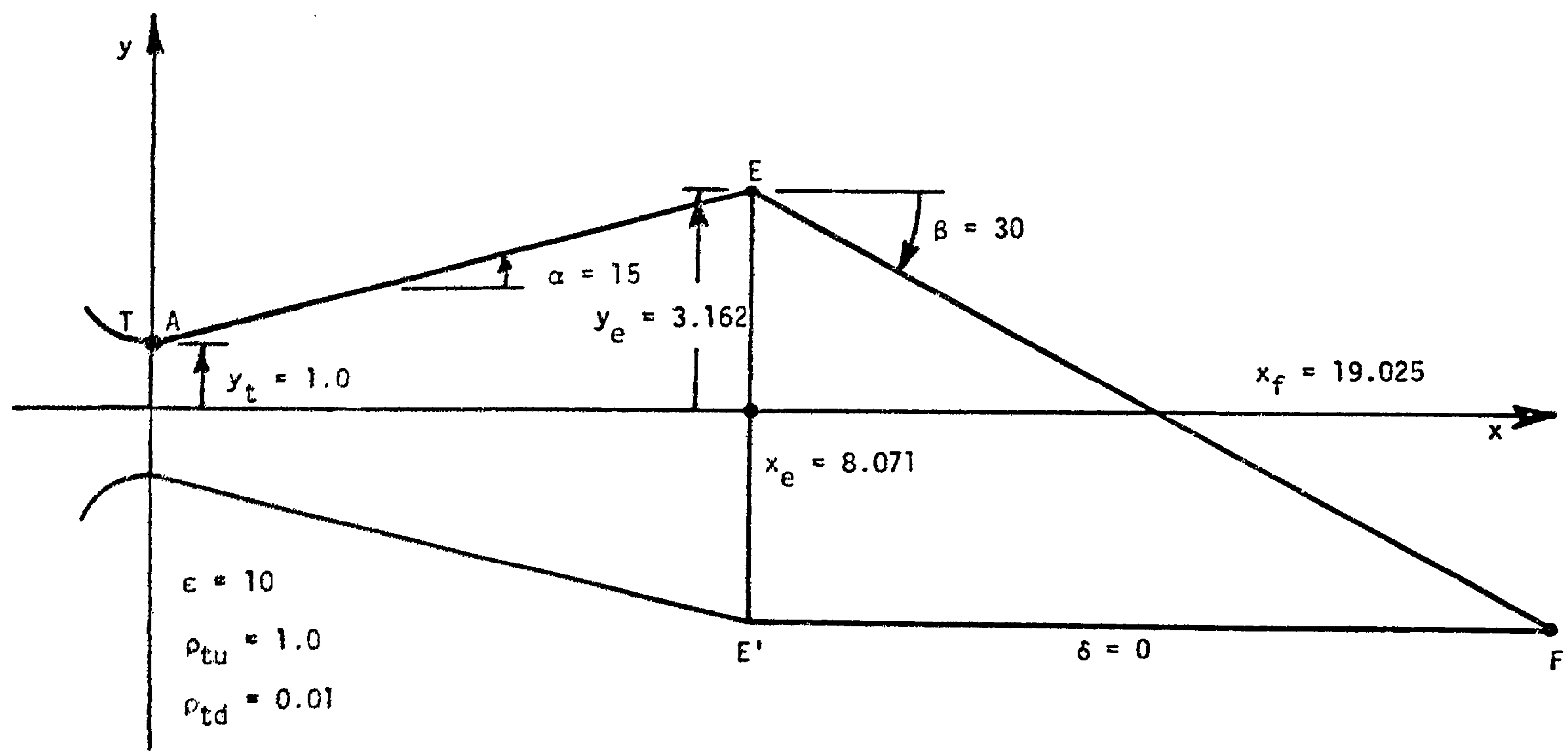


Figure 69. Scarfed nozzle geometry for Sample Case No. 1.

attachment angle θ_a of 15 degrees (AA = 15.0) and an area ratio $\varepsilon = 10$ (EPS = 10.0). The parameters θ_a and ε completely specify the geometry of the conical nozzle. Hence, the exit lip radius y_e and the nozzle length x_e are left at their default values of 0.0 (YE = 0.0 and XE = 0.0). The complete flowfield from the basic nozzle must be calculated since a scarfed extension is present. Thus, XMAX is left at its default value of 1000.0.

The cone angle θ_f of the scarfed conical extension is 0.0 deg (AF = 0.0). The scarf angle β = 30.0 deg (BETA = 30.0). The parameters θ_f and β completely specify the geometry of the scarfed conical extension. Hence, the length x_f of the scarfed conical extension is left at its default value of 0.0 (XF = 0.0).

Two applications of the corrector (ICOR = 2) are to be made in the modified-Euler predictor-corrector numerical integration procedure used in the method of characteristics unit processes. All flowfield points are to be corrected two times, so the convergence tolerances are set equal to 0.0 (E1 = 0.0 and E2 = 0.0).

This completes the specification of namelist DATA. Since the initial-value line and the basic nozzle contour are internally generated (IVS = 1 and IWALL = 1), namelists IVSL and WALL are omitted from the data deck. The data deck for Sample Case No. 1 is presented below.

```
SAMPLE CASE NO. 1.  NOMINAL CASE WITH AA=15, EPS=10, AF=0, AND BETA=30
 $DATA MODE=4, IWALL=1, NI=11, NT=15, KWRITE=2,
 G=1.2, RG=65.0, PS=1000.0, TS=5000.0, PA=14.696,
 YT=1.0, RTU=1.0, RTD=0.01, AA=15.0, EPS=10.0, AF=0.0, BETA=30.0 $
```

The computer output for Sample Case No. 1 is presented in Append. A. The first page presents the program abstract, the job title, the problem specifications, and the thermodynamic model. The second page describes the nozzle geometry. The next two pages present a complete listing of namelist DATA. The fifth page presents the initial-value line properties and performance parameters.

The three following pages present the flow properties at each point along the right-running Mach lines emanating from the initial-value line, as illustrated in Figure 36. The first point in each set of data is the initial-value line point. That point is followed by the succeeding points along the right-running Mach line. The last point in each set of data is the point where the right-running Mach line intersects the nozzle axis. Since 11 points were specified on the initial-value line (NI = 11), 11 right-running characteristics are present in this initial portion of the flowfield (I = 1 to 11).

The next nine pages present the flow properties at each point along the right-running Mach lines emanating from the prespecified points on the initial expansion contour, that is, the circular arc throat downstream radius of curvature, as illustrated in Figure 40. Since 15 points were specified along the initial-expansion contour (NT = 15), 15 right-running characteristics are present in this portion of the flowfield (I = 12 to 26). The nozzle performance parameters at each prespecified wall point are listed ahead of the corresponding Mach line data.

The next 10 pages present the flow properties at each point along the left-running characteristics emanating from points along the final right-running characteristic from the initial-expansion contour, as

illustrated in Figure 50. The nozzle performance parameters at each direct wall point at the end of each left-running Mach line are listed at the end of each set of Mach line points. These left-running Mach lines are generated until the end of the basic nozzle contour is reached. In this sample case, 30 left-running Mach lines are required (J = 1 to 30). The last point (I = 55, J = 30) is the exit lip point of the basic nozzle, point E.

The next 12 pages present the flow properties at each point along the left-running characteristics that reach the scarfed nozzle extension. All of these Mach lines pass through the right-running oblique shock wave emanating from the junction between the basic nozzle contour and the scarfed nozzle extension, point E. The first point (I = 55, J = 30) is the shock wave point at point E itself. Each shock wave point has two lines of data: the first line contains the flow properties on the upstream side of the shock wave and the second line contains the flow properties on the downstream side of the shock wave. The nozzle performance parameters at each point on the scarfed nozzle extension at the end of each left-running Mach line are listed at the end of each set of Mach line points. These left-running Mach lines are generated until the end of the scarfed nozzle extension is reached. In this sample case, 20 left-running Mach lines are required (J = 31 to 50). The last point (I = 71, J = 50) is the exit lip point of the scarfed nozzle extension, point F.

The next two pages present a summary of the nozzle performance parameters at each point along the nozzle wall contour calculated during the method of characteristics analysis.

The next page summarizes the performance of the scarfed nozzle

extension.

The final page of output presents a summary of the overall scarfed nozzle performance parameters and a summary of the overall missile performance parameters. The final result of the analysis is the axial specific impulse delivered to the missile, denoted by ISPXM. For the present sample case, this value is 206.785 (lbf-sec)/lbm.

This computer run required approximately 25 sec of CPU time on a CDC 6500 computer and generated approximately 2100 lines of printed output.

In many cases, the amount of output described above is not needed. A considerable reduction in output is achieved by setting KWRITE = 1. In that case, every section of output described about is still obtained, but only the first, last, and shock wave points are written out along each characteristic. For Sample Case No. 1 with KWRITE = 1, approximately 21 sec of CPU time were required and approximately 500 lines of printed output were generated. Even less printed output is obtained by setting KWRITE = 4. In that case, only the first two pages describing the problem specifications and the last page summarizing the overall performance parameters are written out. For Sample Case No. 1 with KWRITE = 4, approximately 15 sec of CPU time were required and approximately 70 lines of printed output were generated. The portion of the output for Sample Case No. 1 that is abbreviated by setting KWRITE = 1 is presented in Append. B.

3. SAMPLE CASE NO. 2

Sample Case No. 2 is identical to Sample Case No. 1, except that the conical portion of the basic nozzle is specified by the exit radius y_e instead of the cone angle θ_a, and the amount of output is reduced. The identical basic nozzle contour is obtained for y_e = 3.16227766 in. Thus, the only changes to the input data are to delete AA = 15.0, to add YE = 3.16227766, and to change KWRITE to 1. The data deck for Sample Case No. 2 is presented below. The output is identical to the abbreviated output for Sample Case No. 1.

```
SAMPLE CASE NO. 2.  NOMINAL CASE WITH YE=3.16227766 SPECIFIED
 $DATA MO[illegible]=[illegible], IWALL=1, NI=11, NT=15, KWRITE=1,
 G=1.2, RG=65.0, PS=1000.0, TS=5000.0, PA=14.696,
 YT=1.0, RTU=1.0, RTD=0.01, AA=15.0, YE=3.16227766, AF=0.0, BETA=30.0 $
```

4. SAMPLE CASE NO. 3

Sample Case No. 3 is identical to Sample Case No. 1, except that the conical portion of the basic nozzle is specified by the nozzle length x_e instead of the cone angle θ_a. The identical basic nozzle is obtained for x_e = 8.07104661 in. Thus, the only changes to the input data are AA = 0.0 and XE = 8.07104661. The data deck for Sample Case No. 3 is presented below. The output is identical to the abbreviated output for Sample Case No. 1.

```
SAMPLE CASE NO. 3.  NOMINAL CASE WITH XE=8.07104661 SPECIFIED
 $DATA MODE=4, IWALL=1, NI=11, NT=15, KWRITE=1,
 G=1.2, RG=65.0, PS=1000.0, TS=5000.0, PA=14.696,
 YT=1.0, RTU=1.0, RTD=0.01, AA=15.0, XE=8.07104661, AF=0.0, BETA=30.0 $
```

5. SAMPLE CASE NO. 4

Sample Case No. 4 is identical to Sample Case No. 1, except that the supersonic contour of the basic nozzle is read in as tabular data from TAPE5 (IWALL=5). For the tabular wall option, the basic nozzle throat contour must still be specified, since the first point in the wall contour table is computed internally as point A. Thus, the throat attachment angle must be explicitly specified as 15.0 deg (AA=15.0). The basic nozzle exit lip point, point E, is internally defined to be the last point in the wall table. Thus, x_e and y_e or ε (i.e., XE, YE, and EPS) do not need to be input. Thus, the only change in the input parameters required in namelist DATA is IWALL=5.

For the tabular wall option, namelist WALL must be specified. Only two points are required to specify a conical wall (NWALL=2). The first point can be any point downstream of the throat attachment point, point A. For a contoured nozzle, the first point should be close to point A to achieve an accurate representation of the nozzle wall. For a conical wall, the location of the first point is irrelevant, as long as it lies between the points A and E. That point is specified as (4.03681741, 2.08130920), which is exactly midway between points A and E. The last point is point E (8.07104661, 3.16227766).

The data deck for Sample Case No. 4 is presented below.

SAMPLE CASE NO. 4. NOMINAL CASE WITH TABULAR NOZZLE WALL

```
 $DATA MODE=4, IWALL=5, NI=11, NT=15, KWRITE=1,
 G=1.2, RG=65.0, PS=1000.0, TS=5000.0, PA=14.696,
 YT=1.0, RTU=1.0, RTD=0.01, AA=15.0, AF=0.0, BETA=30.0, $
 $WALL NWALL=2, XW(2)=4.03681741, 8.07104661,
                YW(2)=2.08130920, 3.16227766 $
```

The output for Sample Case No. 4 is the same as the abbreviated output for Sample Case No. 1, except that the tabular wall data are written out on the second page of output. That page is presented in Append. C.

6. SAMPLE CASE NO. 5

Sample Case No. 5 is identical to Sample Case No. 1, except that the initial-value line is read in as tabular data from TAPE5 (IVS=5). The initial-value data are taken from the output of Sample Case No. 1. The only change in the input required in namelist DATA is IVS=5.

For the tabular initial-value line option, namelist IVSL must be specified. The point locations and flow properties are taken directly from the output of Sample Case No. 1.

The data deck for Sample Case No. 5 is presented below.

The output for Sample Case No. 5 is the same as the abbreviated output for Sample Case No. 1.

```
SAMPLE CASE NO. 5.  NOMINAL CASE WITH TABULAR INITIAL-VALUE LINE
 $DATA MODE=4, IWALL=1, NI=11, NT=15, IVS=5, KWRITE=1,
 G=1.2, RG=65.0, PS=1000.0, TS=5000.0, PA=14.696,
 YT=1.0, RTU=1.0, RTD=0.01, AA=15.0, AF=0.0, BETA=30.0 $
 $IVSL XI(1)= 0.262, 0.260, 0.252, 0.239, 0.220, 0.197, 0.168,
              0.134, 0.094, 0.050, 0.000,
       YI(1)= 0.000, 0.100, 0.200, 0.300, 0.400, 0.500, 0.600,
              0.700, 0.800, 0.900, 1.000,
       MI(1)= 1.031, 1.032, 1.035, 1.041, 1.049, 1.060, 1.075,
              1.095, 1.121, 1.156, 1.203,
       TI(1)= 0.000, 0.110, 0.210, 0.300, 0.370, 0.410, 0.400,
              0.350, 0.260, 0.130, 0.000 $
```

7. SAMPLE CASE NO. 6

Sample Case No. 6 illustrates the option of starting the left-running characteristic network construction from the last right-running characteristic from the initial-value line instead of from the last right-running characteristic from the initial expansion contour. This option is useful when the shock wave intersects the last right-running characteristic from the initial expansion contour. This option is specified by MODE=5. All other parameters are identical to the data for Sample Case No. 1. The data deck for Sample Case No. 6 is presented below. The output for Sample Case No. 6 is presented in Append. D.

```
SAMPLE CASE NO. 6.  NOMINAL CASE WITH MODE=5
 $DATA MODE=5, IWALL=1, NI=11, NT=15, KWRITE=2,
 G=1.2, RG=65.0, PS=1000.0, TS=5000.0, PA=14.696,
 YT=1.0, RTU=1.0, RTD=0.01, AA=15.0, EPS=10.0, AF=0.0, BETA=30.0 $
```

The first six pages of output for Sample Case No. 6 are identical to the output for Sample Case No. 1. The next two pages present the solution along the first left-running characteristic (J=2) emanating from the downstream extent of the initial-value line. The next ten pages present the solution along the 28 left-running characteristics (J= 3 to 30) that reach the wall of the basic nozzle. Although calculated in a different order from Sample Case No. 1, the same data points are calculated and the same solution is obtained. The remainder of the output is identical to the output for Sample Case No. 1.

8. SAMPLE CASE NO. 7

Sample Case No. 7 illustrates the use of the variable step size options on the initial-value line and the throat downstream circular arc contour. In all other respects, Sample Case No. 7 is identical to Sample Case No. 1. The value of Δy on the initial-value line at the nozzle wall is to be one half as large as the value of Δy adjacent to the nozzle axis (DYRATIO=0.5). The value of $\Delta\theta$ adjacent to the throat attachment point, point A, is to be twice as large as the value of $\Delta\theta$ adjacent to the nozzle throat (DARATIO=2.0). The data deck for Sample Case No. 7 is presented below.

```
SAMPLE CASE NO. 7.  NOMINAL CASE WITH DYRATIO=0.5 AND DARATIO=2.0
 $DATA MODE=4, IWALL=1, NI=11, NT=15, KWRITE=1, DYRATIO=0.5, DARATIO=2.0,
 G=1.2, RG=65.0, PS=1000.0, TS=5000.0, PA=14.696,
 YT=1.0, RTU=1.0, RTD=0.01, AA=15.0, AF=0.0, BETA=30.0 $
```

9. SAMPLE CASE NO. 8.

Sample Case No. 8 is the same as Sample Case No. 1, except that the x coordinate of the end of the scarfed nozzle extension, point F, is specified instead of the scarf angle β. The same scarfed nozzle extension is obtained for x_f = 19.02549776 in. The only change in the input data deck is the deletion of BETA = 30.0 and the addition of XF = 19.02549776. The data deck for Sample Case No. 8 is presented below. The output for Sample Case No. 8 is the same as the abbreviated output for Sample Case No. 1.

```
SAMPLE CASE NO. 8.  NOMINAL CASE WITH XF=19.02549776 SPECIFIED
 $DATA NODE=4, IWALL=1, NI=11, NT=15, KWRITE=1,
 G=1.2, RG=65.0, PS=1000.0, TS=5000.0, PA=14.696,
 YT=1.0, RTU=1.0, RTD=0.01, AA=15.0, EPS=10.0, AF=0.0, XF=19.02549776 $
```

10. SAMPLE CASE NO. 9

Sample Case No. 9 considers the same basic nozzle and operating conditions as Sample Case No. 1. In Sample Case No. 9, however, the scarfed nozzle extension is a cone with an angle θ_f = 5.0 deg (AF=5.0). The data deck for Sample Case No. 9 is presented below.

```
SAMPLE CASE NO. 9.  NOMINAL CASE WITH AF=5.0
 $DATA MODE=4, IWALL=1, NI=11, NT=15, KWRITE=1,
 G=1.2, RG=65.0, PS=1000.0, TS=5000.0, PA=14.696,
 YT=1.0, RTU=1.0, RTD=0.01, AA=15.0, EPS=10.0, AF=5.0, BETA=30.0 $
```

The output for Sample Case No. 9 is identical to the output of Sample Case No. 1 through the basic nozzle flowfield. The oblique shock wave and the flowfield in the nozzle extension are different. Append. E presents that portion of the output downstream of the basic nozzle.

11. SAMPLE CASE NO. 10

Sample Case No. 10 illustrates a scarfed conical nozzle where the cone angle of the basic nozzle θ_a and the cone angle of the conical extension θ_f are identical, in this case 15.0 deg (AA=15.0 and AF=15.0). Thus, the flow turning angle at point E, the juction of the basic nozzle and the nozzle extension, is zero. In that case, the oblique shock wave emanating from point E becomes a Mach line, and the flow properties across the junction are continuous. The data deck for Sample Case No. 10 is presented below.

```
SAMPLE CASE NO. 10.  NOMINAL CASE WITH AA=AF=15.0
 $DATA MODE=4, IWALL=1, NI=11, NT=15, KWRITE=1,
 G=1.2, RG=65.0, PS=1000.0, TS=5000.0, PA=14.696,
 YT=1.0, RTU=1.0, RTD=0.01, AA=15.0, EPS=10.0, AF=15.0, BETA=30.0 $
```

The output for Sample Case No. 10 is identical to the output for Sample Case No. 1 through the basic nozzle flowfield. The flowfield in the nozzle extension is different. Append. F presents that portion of the output downstream of the basic nozzle. Note that the oblique shock wave emanating from point E, the junction point between the basic nozzle and the conical extension, is basically a Mach line. The strength of the oblique shock wave does not remain infinitesimal, as it theoretically should. This discrepancy is due to numerical errors introduced by using the rotational flow method of characteristics downstream of the pseudo shock wave to calculate an irrotational flowfield. However, the errors are relatively minor.

12. SAMPLE CASE NO. 11

Sample Case No. 11 is identical to Sample Case No. 1, except that the basic nozzle has a length of 28.51233074 in. (XE=28.51233074) and there is no nozzle extension (MODE=1). Consequently, the problem being analyzed is simply a 15 deg conical nozzle 28.51233074 in. long. The flowfield in this nozzle is identical to the flowfield in the basic nozzle and nozzle extension considered in Sample Case No. 10. The output is slightly different, however, since the present nozzle does not have a special junction point at x = 8.07104661 in. A close comparison of the output from the two sample cases clearly shows that the flowfields are essentially identical. The data deck for Sample Case No. 11 is presented below.

```
SAMPLE CASE NO. 11.  CONICAL NOZZLE CORRESPONDING TO CASE 10, MODE=1
 $DATA MODE=1, IWALL=1, NI=11, NT=15, KWRITE=1,
 G=1.2, RG=65.0, PS=1000.0, TS=5000.0, PA=14.696,
 YT=1.0, RTU=1.0, RTD=0.01, AA=15.0, XE=28.51233074 $
```

The output for Sample Case No. 11 is identical to the output for Sample Case No. 1 through left-running Mach line 29. The flowfield downstream of that Mach line is the same as the flowfield determined in Sample Case No. 10. The right-running and left-running Mach lines are not identical, however, since the special point at x = 8.07104661 in. considered in Sample Case No. 10 is not considered in Sample Case No. 11. The flowfield downstream of left-running Mach line 29 in Sample Case No. 11 is presented in Append. G.

13. SAMPLE CASE NO. 12

Sample Case No. 12 is identical to Sample Case No. 11 except that the left-running characteristic network is initiated from the last right-running characteristic from the initial-value line instead of from the last right-running characteristic from the initial expansion contour. Since Sample Case No. 11 involved a basic nozzle only (MODE = 1), this sample case also involves only a basic nozzle. The analysis of a basic only by emanating left-running characteristics from the downstream extent of the initial-value line is selected by specifying MODE=2. Such an analysis in a basic nozzle is analogous to MODE=5 in a scarfed nozzle. The only change required to the data deck for Sample Case No. 11 to obtain Sample Case No. 12 is to change MODE from 1 to 2. The data deck for Sample Case No. 12 is presented below.

```
SAMPLE CASE NO. 12.  SAMPLE CASE NO. 11 WITH MODE=2
 $DATA MODE=2, IWALL=1, NI=11, NT=15, KWRITE=1,
 G=1.2, RG=65.0, PS=1000.0, TS=5000.0, PA=14.696,
 YT=1.0, RTU=1.0, RTD=0.01, AA=15.0, XE=28.51233074 $
```

The output format for Sample Case No. 12 is similar to the output format for Sample Case No. 6 presented in Section VIII.7.

14. SAMPLE CASE NO. 13

Sample Case No. 13 illustrates the quadratic wall option for the basic nozzle (IWALL=2). The envelope of the quadratic wall is identical to the envelope of the conical nozzle considered in Sample Case No. 1. The throat attachment angle is θ_a = 25.0 deg, 25 points are to be specified along the throat downstream circular arc contour, the nozzle area ratio ε = 10.0, and the nozzle length is x_e = 8.07104661 in. (AA=25.0, NT=25.0, EPS=10.0, and XE=8.07104661). The same cylindrical nozzle extension considered in Sample Case No. 1 is considered here. All of the remaining parameters in namelist DATA are the same as for Sample Case No. 1. The data deck for Sample Case No. 12 is presented below.

```
SAMPLE CASE NO. 13.  QUADRATIC WALL, AA=25.0, XE=8.07104661, EPS=10.0
 $DATA MODE=4, IWALL=2, NI=11, NT=25, KWRITE=1,
 G=1.2, RG=65.0, PS=1000.0, TS=5000.0, PA=14.696,
 YT=1.0, RTU=1.0, RTD=0.01, AA=25.0, XE=8.07104661, EPS=10.0,
 AF=0.0, BETA=30.0 $
```

The output for Sample Case No. 13 is presented in Append. H.

15. SAMPLE CASE NO. 14

Sample Case No. 14 is identical to Sample Case No. 13, except that the quadratic portion of the basic nozzle is specified by the exit lip radius y_e instead of the area ratio ε. The identical quadratic contour is obtained for y_e = 3.16227766 in. Thus, the only changes to the input data are to delete EPS = 10.0 and to add YE = 3.16227766. The data deck for Sample Case No. 14 is presented below.

```
SAMPLE CASE NO. 14.  QUADRATIC WALL, AA=25.0, XE=8.07104661, YE=3.16227766
 $DATA MODE=4, IWALL=2, NI=11, NT=25, KWRITE=1,
 G=1.2, RG=65.0, PS=1000.0, TS=5000.0, PA=14.696,
 YT=1.0, RTU=1.0, RTD=0.01, AA=25.0, XE=8.07104661, YE=3.16227766,
 AF=0.0, BETA=30.0 $
```

The output for Sample Case No. 14 is identical to the output for Sample Case No. 13.

16. SAMPLE CASE NO. 15.

Sample Case No. 15 is identical to Sample Case No. 13, except that the quadratic portion of the basic nozzle is specified by the exit lip angle θ_e instead of the area ratio ε. The identical quadratic contour is obtained for θ_e = 3.97861353 deg. Thus, the only changes to the input data are to delete EPS = 10.0 and to add AE = 3.97861353. The data deck for Sample Case No. 15 is presented below.

```
SAMPLE CASE NO. 15.  QUADRATIC WALL, AA=25.0, XE=8.07104662, AE=3.97861353
 $DATA MODE=4, IWALL=2, NI=11, NT=25, KWRITE=1,
 G=1.2, RG=65.0, PS=1000.0, TS=5000.0, PA=14.696,
 YT=1.0, RTU=1.0, RTD=0.01, AA=25.0, XE=8.07104661, AE=3.97861353,
 AF=0.0, BETA=30.0 $
```

The output for Sample Case No. 15 is identical to the output for Sample Case No. 13.

SECTION IX

CONCLUSIONS

An analysis is presented for predicting the performance of canted scarfed propulsive nozzles. A computer program based on that analysis was developed. Fifteen sample cases are presented to illustrate the use of the computer program.

REFERENCES

1. Zucrow, M.J., and Hoffman, J.D., Gas Dynamics, Vol. 2, Section 15-5, John Wiley and Sons, New York, 1977, pp. 86-110.

2. Kliegel, J.R., and Levine, J.N., "Transonic Flow in Small Throat Radius of Curvature Nozzles," AIAA Journal, Vol. 7, July 1969, pp. 1375-1378.

3. Sauer, R., "General Characteristics of the Flow Through Nozzles at Near Critical Speeds," NACA TM No. 1215, 1949.

4. Zucrow, M.J., and Hoffman, J.D., Gas Dynamics, Vol. 1, Chapter 3, John Wiley and Sons, New York, 1976, pp. 102-159.

5. Reference (4), Chapter 10, pp. 511-554.

6. Reference (4), Chapter 12, pp. 580-621.

7. Reference (1), Chapter 16, pp. 112-184.

8. Reference (4), Sections 7-6 and 7-7, pp. 356-369.

9. Reference (1), Chapter 17, pp. 185-266.

10. Reference (4), Appendix A, pp. 669-694.

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APPENDIX A

OUTPUT FOR SAMPLE CASE NO. 1

```
NOZZLE PERFORMANCE PREDICTION PROGRAM.

THIS PROGRAM WILL ANALYZE THE FLOWFIELD AND PERFORMANCE OF PROPULSIVE NOZZLES FOR SEVERAL OPTIONS.

  MODE 1. IRROTATIONAL FLOW ALONG RIGHT-RUNNING CHARACTERISTICS.

  MODE 2. IRROTATIONAL FLOW ALONG LEFT-RUNNING CHARACTERISTICS.

  MODE 3. FLOW WITH AN EMBEDDED RIGHT-RUNNING OBLIQUE SHOCK WAVE.

  MODE 4. FLOW IN A SCARFED NOZZLE EXTENSION.

THE PROGRAM WILL ANALYZE THE PERFORMANCE OF A COMPRESSED PROPULSIVE NOZZLE. ICMP = 1.

THE PROGRAM CAN DETECT AND TRACK AN EMBEDDED RIGHT-RUNNING OBLIQUE SHOCK WAVE (MODE = 3 OR 5).  THE FLOWFIELD AHEAD OF
THE SHOCK WAVE IS ASSUMED TO BE IRROTATIONAL. AND THE FLOWFIELD DOWNSTREAM OF THE SHOCK WAVE IS ASSUMED TO BE ROTATIONAL.

THIS PROGRAM WAS WRITTEN BY JOE D. HOFFMAN. SCHOOL OF MECHANICAL ENGINEERING. PURDUE UNIVERSITY. WEST LAFAYETTE IN 47907.
TELEPHONE NUMBER 317-494-15[illegible]


JOB TITLE -

   SAMPLE CASE NO. 1.  NOMINAL CASE WITH AE=15.0. EPS=10.0. AF=0.0. AND BETA=30.0


PROBLEM SPECIFICATIONS -

   ANALYSIS OF A SCARFED NOZZLE WITH AN ATTACHED RIGHT-RUNNING OBLIQUE SHOCK WAVE.

   THE ANALYSIS IS PERFORMED IN EE UNITS (LBF. LBM. IN.. FT/SEC. R).

   THERE ARE 11 POINTS ALONG THE INITIAL-VALUE LINE. AND 15 POINTS ALONG THE CIRCULAR ARC THROAT CONTOUR.

   THE OUTPUT FLAGS ARE IWRITE =   0. JWRITE =   0. AND KWRITE = 2.

   THE GRID SPACING CONTROL PARAMETERS ARE DYRATIO = 1.000 AND DARATIO = 1.000.

   THE ACCURACY CONTROL PARAMETERS ARE ICORT =  2.  E1 =  0.       .  AND E2 =  0.       .


THERMODYNAMIC MODEL -

   G = 1.250.  RG = 55.000 (FT-LBF)/(LBM-R).  PS =  1000. LBF/IN.**2.  TS =  5000. R.  AND  PA =  15. LBF/IN.**2.
```

```
NOZZLE GEOMETRIC SPECIFICATIONS -

   THE NOZZLE CROSS-SECTION IS AXISYMMETRIC.

   THE NOZZLE THROAT GEOMETRY IS SPECIFIED BY YT =  1.000 IN.,  RTU =  1.000 IN., AND RTD =   .010 IN.

   THE NOZZLE CONTOUR IS CONICAL. AA =  15.000 DEG. YE =    3.162 IN., AND EPS =  10.000.

   THE NOZZLE LENGTH XE =    8.071 IN. AND THE EXIT RADIUS YE =    3.162 IN.

   THE CHARACTERISTIC GRID IS STOPPED AT XMAX = 1000.000 IN.
 GEOMETRIC SPECIFICATION OF THE SCARFED EXTENSION.

   XE =    8.071 IN. AND YE =    3.162 IN.

   XF =   19.025 IN., YF =    3.162 IN., AND AF =  0.000 DEG.

   THE SCARF ANGLE BETA = 30.000 DEG.

 $DATA

 IUNITS  = 1.

 MODE    = 4.

 IWALL   = 1.

 JWALL   = 0.

 NI      = 11.

 NT      = 15.

 IVS     = 1.

 IOUT    = 1.

 IWRITE  = 0.

 JWRITE  = 0.

 KWRITE  = 2.

 LWRITE  = 0.

 MWRITE  = 0.

 NWRITE  = 0.

 G       = .12E+01.

 RG      = .65E+02.

 PS      = .1E+04.

 TS      = .5E+04.

 PA      = .14696E+02.

 DELTA   = .1E+01.

 YT      = .1E+01.
```

```
RTU     = .1E+01,
RTO     = .1E-01,
AA      = .15E+01,
AE      = .15E+02,
EPS     = .1E+02,
VI      = .31622776601684E+01,
VC      = .80710466127954E+01,
XMAX    = .1E+04,
AF      = 0.0,
ZF      = .19025497762899E+02,
BETA    = .3E+02,
DYRATIO = .1E+01,
DARATIO = .1E+01,
ICORI   = 2,
ICORR   = 3,
E1      = 0.0,
E2      = 0.0,
IOURP   = 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
ICMP    = 0,
IPLOT   = 0,
ISPLOT  = 0,
YMAX    = .25E+02,
XDES    = 0.0,
YDES    = 0.0,
IF      = 0,
JE      = 0,
&END
```

INITIAL-VALUE LINE SPECIFICATIONS.

INITIAL-VALUE LINE CALCULATED BY THE KLIEGEL-LEVINE METHOD.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
1	11	.262	0.000	3471.	0.	1.031	3471.	0.00	545.67	.26746	4520.	1000.	5000.	0.000	0.
2	10	.260	.100	3475.	7.	1.032	3475.	.11	545.00	.26719	4519.	1000.	5000.	.203	59.
3	9	.252	.200	3485.	13.	1.035	3485.	.21	542.99	.26636	4516.	1000.	5000.	.610	154.
4	8	.239	.300	3502.	19.	1.041	3502.	.30	539.56	.26496	4511.	1000.	5000.	1.823	347.
5	7	.220	.400	3527.	23.	1.049	3527.	.37	534.58	.26292	4504.	1000.	5000.	3.241	617.
6	6	.197	.500	3560.	25.	1.060	3561.	.41	527.79	.26013	4495.	1000.	5000.	5.063	963.
7	5	.168	.600	3605.	25.	1.075	3606.	.40	518.81	.25644	4482.	1000.	5000.	7.288	1387.
8	4	.134	.700	3665.	22.	1.095	3665.	.35	507.02	.25157	4465.	1000.	5000.	9.912	1887.
9	3	.094	.800	3743.	17.	1.121	3743.	.26	491.54	.24516	4442.	1000.	5000.	12.928	2462.
10	2	.050	.900	3846.	9.	1.156	3846.	.13	471.15	.23665	4411.	1000.	5000.	16.321	3112.
11	1	0.000	1.000	3984.	-0.	1.203	3984.	-.00	444.24	.22534	4368.	1000.	5000.	20.069	3832.

INITIAL-VALUE LINE PERFORMANCE PARAMETERS.

MDOT = 20.069 LBM/SEC.   MDOT(I-D) = 20.272 LBM/SEC.   CD = .9900

F = 3832. LBF.   F(I-D) = 3855. LBF.   ETAF = .9940

ISP = 190.942 LBF-SEC/LBM.   ISP(I-D) = 190.176 LBF-SEC/LBM.   ETAI = 1.0040

IRROTATIONAL FLOWFIELD ALONG RIGHT-RUNNING CHARACTERISTICS EMANATING FROM THE INITIAL-VALUE LINE.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
1	11	.262	0.000	3471.	0.	1.031	3471.	0.000	545.669	.26746	4520.	1000.	5000.	0.000	0.
2	10	.260	.100	3475.	7.	1.032	3475.	.110	545.005	.26719	4519.	1000.	5000.	.203	39.
2	11	.274	.046	3500.	4.	1.040	3500.	.063	539.987	.26513	4512.	1000.	5000.	.042	8.
2	12	.288	0.000	3525.	0.	1.048	3525.	0.000	534.839	.26303	4505.	1000.	5000.	-.000	-0.
3	9	.252	.203	3485.	13.	1.035	3485.	.214	542.993	.26636	4516.	1000.	5000.	.810	154.
3	10	.270	.137	3505.	12.	1.042	3505.	.198	538.937	.26470	4511.	1000.	5000.	.380	72.
3	11	.286	.084	3531.	9.	1.050	3531.	.153	533.757	.26258	4503.	1000.	5000.	.143	27.
3	12	.301	.039	3558.	6.	1.059	3558.	.090	528.210	.26031	4495.	1000.	5000.	.031	6.
3	13	.316	0.000	3589.	0.	1.070	3589.	0.000	522.075	.25778	4487.	1000.	5000.	-.000	-0.
4	8	.234	.330	3502.	19.	1.041	3502.	.303	539.563	.26496	4511.	1000.	5000.	1.823	347.
4	9	.260	.229	3515.	20.	1.045	3515.	.321	536.839	.26385	4508.	1000.	5000.	1.065	203.
4	10	.279	.169	3537.	19.	1.052	3537.	.306	532.550	.26209	4502.	1000.	5000.	.578	110.
4	11	.297	.118	3563.	16.	1.061	3563.	.262	527.233	.25990	4494.	1000.	5000.	.279	53.
4	12	.31[illegible]	.074	3592.	12.	1.071	3592.	.199	521.502	.25755	4486.	1000.	5000.	.109	21.
4	13	.329	.035	3624.	7.	1.081	3620.	.109	515.178	.25494	4477.	1000.	5000.	.024	5.
4	14	.344	0.000	3656.	0.	1.092	3656.	0.000	508.677	.25226	4467.	1000.	5000.	-.000	-0.
5	7	.220	.458	3527.	23.	1.049	3527.	.371	534.577	.26292	4504.	1000.	5000.	3.241	617.
5	8	.245	.323	3532.	26.	1.051	3532.	.428	533.488	.26247	4503.	1000.	5000.	2.112	402.
5	9	.268	.256	3547.	28.	1.056	3547.	.447	530.408	.26121	4499.	1000.	5000.	1.323	252.
5	10	.289	.198	3570.	27.	1.063	3570.	.433	525.907	.25936	4492.	1000.	5000.	.790	150.
5	11	.308	.148	3597.	24.	1.072	3597.	.390	520.461	.25712	4484.	1000.	5000.	.440	84.
5	12	.326	.105	3627.	21.	1.082	3627.	.326	514.610	.25471	4476.	1000.	5000.	.220	42.
5	13	.342	.066	3659.	15.	1.093	3659.	.237	508.192	.25206	4467.	1000.	5000.	.088	17.
5	14	.358	.032	3692.	8.	1.104	3692.	.127	501.544	.24931	4457.	1000.	5000.	.020	4.
5	15	.374	0.000	3726.	0.	1.116	3726.	0.000	494.749	.24649	4447.	1000.	5000.	-.000	-0.
6	6	.197	.566	3560.	25.	1.050	3561.	.406	527.790	.26013	4495.	1000.	5000.	5.063	963.
6	7	.226	.414	3556.	32.	1.059	3556.	.512	528.615	.26047	4496.	1000.	5000.	3.538	673.
6	8	.253	.345	3564.	36.	1.061	3564.	.572	527.046	.25983	4494.	1000.	5000.	2.405	458.
6	9	.277	.283	3581.	37.	1.067	3581.	.595	523.650	.25843	4489.	1000.	5000.	1.590	303.
6	10	.299	.224	3605.	36.	1.075	3605.	.579	518.952	.25650	4482.	1000.	5000.	1.017	194.
6	11	.319	.176	3633.	34.	1.084	3633.	.536	513.384	.25420	4474.	1000.	5000.	.622	119.
6	12	.338	.133	3662.	30.	1.094	3663.	.472	507.432	.25175	4465.	1000.	5000.	.358	68.
6	13	.356	.095	3695.	25.	1.105	3695.	.385	500.954	.24906	4456.	1000.	5000.	.183	35.
6	14	.372	.061	3729.	18.	1.116	3729.	.274	494.238	.24628	4446.	1000.	5000.	.075	14.
6	15	.389	.030	3764.	10.	1.128	3764.	.146	487.332	.24341	4435.	1000.	5000.	.017	3.
6	16	.405	0.000	3800.	0.	1.140	3800.	0.000	480.224	.24044	4425.	1000.	5000.	-.000	-0.
7	5	.168	.665	3585.	25.	1.075	3606.	.402	518.807	.25644	4482.	1000.	5000.	7.288	1387.
7	6	.202	.514	3590.	36.	1.070	3591.	.569	521.795	.25767	4486.	1000.	5000.	5.359	1020.
7	7	.233	.436	3589.	43.	1.070	3589.	.679	522.026	.25776	4487.	1000.	5000.	3.852	733.
7	8	.265	.366	3599.	47.	1.073	3599.	.742	520.022	.25694	4484.	1000.	5000.	2.714	517.
7	9	.288	.305	3618.	48.	1.079	3618.	.764	516.330	.25542	4478.	1000.	5000.	1.874	357.
7	10	.309	.251	3642.	44.	1.087	3642.	.751	511.443	.25340	4471.	1000.	5000.	1.266	241.
7	11	.331	.203	3671.	45.	1.097	3671.	.708	505.752	.25105	4463.	1000.	5000.	.830	158.
7	12	.351	.162	3701.	42.	1.107	3701.	.644	499.708	.24855	4454.	1000.	5000.	.525	100.
7	13	.369	.124	3734.	36.	1.118	3734.	.554	493.176	.24584	4444.	1000.	5000.	.309	59.
7	14	.387	.093	3768.	29.	1.130	3769.	.444	486.422	.24303	4434.	1000.	5000.	.163	31.
7	15	.404	.059	3804.	21.	1.142	3804.	.317	479.469	.24013	4423.	1000.	5000.	.069	13.

I	J	X	Y	U	V	W	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
7	16	.421	.029	3840.	11.	1.154	3840.	.171	472.264	.23712	4412.	1000.	5000.	.017	3.
7	17	.438	0.000	3979.	0.	1.157	3879.	0.000	464.615	.23391	4400.	1000.	5000.	-.000	-0.
8	4	.134	.700	3665.	22.	1.095	3655.	.351	507.020	.25157	4465.	1000.	5000.	9.912	1887.
8	5	.173	.612	3637.	38.	1.086	3638.	.599	512.409	.25380	4473.	1000.	5000.	7.587	1444.
8	6	.208	.531	3626.	-49.	1.082	3626.	.773	514.684	.25474	4476.	1000.	5000.	5.697	1084.
8	7	.240	.456	3628.	56.	1.083	3628.	.887	514.332	.25459	4476.	1000.	5000.	4.267	801.
8	8	.269	.389	3640.	61.	1.087	3640.	.953	511.898	.25359	4472.	1000.	5000.	3.062	563.
8	9	.296	.330	3660.	62.	1.093	3660.	.977	507.911	.25194	4466.	1000.	5000.	2.198	419.
8	10	.321	.278	3685.	62.	1.102	3686.	.964	502.828	.24984	4459.	1000.	5000.	1.554	294.
8	11	.344	.232	3715.	60.	1.112	3715.	.921	497.009	.24743	4450.	1000.	5000.	1.075	206.
8	12	.365	.191	3746.	56.	1.122	3746.	.855	490.871	.24488	4441.	1000.	5000.	.732	140.
8	13	.385	.154	3779.	50.	1.133	3779.	.766	484.286	.24214	4431.	1000.	5000.	.476	91.
8	14	.403	.121	3813.	44.	1.145	3814.	.656	477.496	.23931	4420.	1000.	5000.	.291	56.
8	15	.421	.090	3849.	35.	1.157	3849.	.528	470.518	.23639	4410.	1000.	5000.	.161	31.
8	16	.439	.061	3886.	26.	1.170	3886.	.382	463.279	.23335	4398.	1000.	5000.	.072	14.
8	17	.458	.031	3926.	14.	1.183	3926.	.211	455.535	.23010	4386.	1000.	5000.	.019	4.
8	18	.478	0.000	3971.	0.	1.199	3971.	0.000	446.819	.22642	4372.	1000.	5000.	-.001	-0.
9	3	.094	.800	3743.	17.	1.121	3743.	.256	491.543	.24516	4442.	1000.	5000.	12.928	2462.
9	4	.139	.711	3702.	40.	1.107	3702.	.612	499.562	.24849	4454.	1000.	5000.	10.231	1944.
9	5	.179	.628	3679.	56.	1.100	3679.	.870	504.074	.25036	4461.	1000.	5000.	7.966	1516.
9	6	.216	.550	3671.	67.	1.097	3672.	1.051	505.575	.25098	4463.	1000.	5000.	6.116	1164.
9	7	.250	.479	3676.	75.	1.099	3677.	1.170	504.606	.25058	4461.	1000.	5000.	4.642	864.
9	8	.281	.416	3690.	80.	1.104	3691.	1.238	501.715	.24938	4457.	1000.	5000.	3.489	665.
9	9	.309	.359	3712.	82.	1.111	3713.	1.263	497.408	.24759	4451.	1000.	5000.	2.599	496.
9	10	.335	.309	3739.	82.	1.120	3740.	1.251	492.107	.24539	4443.	1000.	5000.	1.918	366.
9	11	.360	.264	3769.	79.	1.130	3770.	1.207	486.145	.24291	4434.	1000.	5000.	1.400	258.
9	12	.382	.225	3801.	76.	1.141	3802.	1.142	479.904	.24031	4424.	1000.	5000.	1.010	193.
9	13	.403	.189	3835.	70.	1.152	3835.	1.050	473.260	.23754	4414.	1000.	5000.	.710	136.
9	14	.423	.156	3870.	63.	1.164	3870.	.940	466.436	.23468	4403.	1000.	5000.	.483	93.
9	15	.442	.126	3905.	55.	1.176	3906.	.811	459.440	.23174	4392.	1000.	5000.	.311	60.
9	16	.461	.096	3943.	46.	1.189	3943.	.664	452.189	.22869	4380.	1000.	5000.	.182	35.
9	17	.481	.067	3983.	34.	1.203	3983.	.493	444.427	.22541	4368.	1000.	5000.	.087	17.
9	18	.502	.036	4028.	20.	1.219	4029.	.281	435.614	.22168	4353.	1000.	5000.	.024	5.
9	19	.528	0.000	4084.	0.	1.238	4084.	0.000	424.917	.21714	4335.	1000.	5000.	-.001	-0.
10	2	.050	.900	3846.	9.	1.156	3846.	.128	471.151	.23665	4411.	1000.	5000.	16.321	3112.
10	3	.100	.811	3790.	42.	1.137	3791.	.633	482.033	.24120	4427.	1000.	5000.	13.294	2532.
10	4	.146	.727	3755.	66.	1.125	3756.	1.004	488.931	.24407	4438.	1000.	5000.	10.685	2035.
10	5	.189	.648	3737.	83.	1.120	3738.	1.272	492.406	.24552	4443.	1000.	5000.	8.489	1617.
10	6	.227	.575	3734.	95.	1.118	3735.	1.461	493.026	.24577	4444.	1000.	5000.	6.682	1273.
10	7	.263	.509	3742.	104.	1.121	3744.	1.585	491.361	.24508	4442.	1000.	5000.	5.221	995.
10	8	.296	.449	3759.	109.	1.127	3761.	1.656	487.955	.24367	4436.	1000.	5000.	4.057	774.
10	9	.326	.396	3783.	111.	1.135	3784.	1.681	483.281	.24172	4429.	1000.	5000.	3.137	599.
10	10	.354	.348	3811.	111.	1.145	3813.	1.669	477.729	.23940	4421.	1000.	5000.	2.415	462.
10	11	.380	.305	3842.	109.	1.155	3844.	1.624	471.599	.23684	4411.	1000.	5000.	1.849	354.
10	12	.404	.267	3875.	105.	1.156	3876.	1.557	465.242	.23418	4401.	1000.	5000.	1.410	270.
10	13	.427	.232	3909.	100.	1.178	3910.	1.464	458.533	.23136	4391.	1000.	5000.	1.059	203.
10	14	.449	.199	3944.	93.	1.190	3946.	1.352	451.676	.22847	4380.	1000.	5000.	.782	150.
10	15	.469	.169	3981.	85.	1.203	3982.	1.222	444.669	.22552	4368.	1000.	5000.	.561	109.
10	16	.490	.141	4018.	75.	1.216	4019.	1.074	437.425	.22245	4356.	1000.	5000.	.394	74.
10	17	.511	.112	4059.	64.	1.230	4059.	.901	429.679	.21916	4343.	1000.	5000.	.241	47.
10	18	.534	.081	4105.	49.	1.246	4105.	.689	420.886	.21542	4328.	1000.	5000.	.125	24.
10	19	.562	.045	4162.	29.	1.266	4162.	.406	410.097	.21081	4310.	1000.	5000.	.037	7.
10	20	.598	0.000	4236.	0.	1.292	4236.	0.000	396.090	.20479	4285.	1000.	5000.	-.002	-0.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	RDOT	F
11	1	0.000	1.000	3984.	-0.	1.203	3984.	-.000	446.242	.22534	4366.	1000.	5000.	20.069	3832.
11	2	.027	.913	3912.	48.	1.178	3912.	.708	458.251	.23124	4390.	1000.	5000.	16.771	3198.
11	3	.119	.827	3865.	83.	1.162	3864.	1.253	467.664	.23519	4405.	1000.	5000.	13.867	2643.
11	4	.158	[illegible]	3834.	108.	1.153	3836.	1.620	473.169	.23750	4414.	1000.	5000.	11.363	2165.
11	5	.203	.677	3822.	127.	1.149	3824.	1.901	475.412	.23844	4417.	1000.	5000.	9.245	1762.
11	6	.244	.610	3824.	140.	1.149	3826.	2.098	475.014	.23827	4417.	1000.	5000.	7.483	1427.
11	7	.283	.548	3836.	149.	1.154	3839.	2.226	472.559	.23724	4413.	1000.	5000.	6.034	1152.
11	8	.318	.493	3856.	155.	1.160	3859.	2.298	468.564	.23557	4407.	1000.	5000.	4.855	928.
11	9	.351	.442	3882.	157.	1.169	3885.	2.323	463.470	.23343	4399.	1000.	5000.	3.900	747.
11	10	.381	.397	3912.	158.	1.180	3915.	2.309	457.627	.23098	4389.	1000.	5000.	3.130	600.
11	11	.410	.356	3944.	156.	1.191	3948.	2.262	451.304	.22832	4379.	1000.	5000.	2.509	482.
11	12	.436	.320	3978.	152.	1.202	3981.	2.191	444.821	.22558	4369.	1000.	5000.	2.012	387.
11	13	.461	.286	4013.	147.	1.214	4016.	2.096	438.047	.22271	4357.	1000.	5000.	1.602	309.
11	14	.484	.255	4049.	140.	1.227	4052.	1.981	431.167	.21979	4346.	1000.	5000.	1.266	244.
11	15	.507	.226	4086.	132.	1.240	4098.	1.849	424.167	.21682	4334.	1000.	5000.	.986	191.
11	16	.529	.199	4124.	122.	1.253	4126.	1.699	416.955	.21374	4322.	1000.	5000.	.751	146.
11	17	.552	.169	4165.	111.	1.267	4166.	1.524	409.264	.21045	4308.	000.	5000.	.547	[illegible]
11	18	.577	.139	4212.	96.	1.283	4215.	1.309	400.551	.20671	4293.	000.	5000.	.365	71.
11	19	.608	.101	4269.	76.	1.304	4270.	1.024	389.866	.20210	4274.	1000.	5000.	.199	39.
11	20	.647	.059	4345.	47.	1.331	4346.	.615	375.804	.19601	4247.	1000.	5000.	.062	12.
11	21	.701	0.000	4450.	0.	1.364	4450.	0.000	356.905	.18776	4211.	1000.	5000.	-.003	-0.

IRROTATIONAL FLOWFIELD ALONG RIGHT-RUNNING CHARACTERISTICS EMANATING FROM THE INITIAL EXPANSION CONTOUR.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
12		F =	3832.0	F1D =		3809.0	ETAF =1.0060		ISP =	190.942	ISP1D =		187.898	ETAI =1.0162	
12	1	.000	1.000	4084.	71.	1.238	4084.	1.000	424.910	.21713	4335.	1000.	5000.	20.069	3832.
12	2	.061	.919	4020.	123.	1.216	4022.	1.746	436.908	.22223	4355.	1000.	5000.	16.984	3237.
12	3	.117	.842	3980.	160.	1.203	3983.	2.306	444.410	.22541	4368.	1000.	5000.	14.276	2722.
12	4	.170	.770	3959.	188.	1.196	3964.	2.721	448.180	.22700	4374.	1000.	5000.	11.941	2277.
12	5	.218	.704	3954.	209.	1.195	3960.	3.025	448.926	.22731	4375.	1000.	5000.	9.956	1900.
12	6	.263	.643	3962.	224.	1.198	3968.	3.239	447.296	.22663	4373.	1000.	5000.	8.284	1583.
12	7	.305	.587	3979.	235.	1.204	3986.	3.381	443.857	.22517	4367.	1000.	5000.	6.888	1318.
12	8	.343	.537	4003.	242.	1.213	4010.	3.463	439.095	.22316	4359.	1000.	5000.	5.728	1098.
12	9	.380	.491	4032.	246.	1.223	4040.	3.495	433.408	.22075	4350.	1000.	5000.	4.767	915.
12	10	.413	.450	4065.	248.	1.234	4073.	3.488	427.107	.21807	4339.	1000.	5000.	3.973	764.
12	11	.445	.412	4100.	247.	1.246	4108.	3.446	420.431	.21522	4328.	1000.	5000.	3.315	639.
12	12	.473	.378	4136.	244.	1.259	4143.	3.381	413.666	.21233	4316.	1000.	5000.	2.775	536.
12	13	.501	.347	4173.	240.	1.272	4180.	3.291	406.672	.20934	4304.	1000.	5000.	2.317	449.
12	14	.527	.317	4211.	234.	1.285	4218.	3.183	399.609	.20630	4291.	1000.	5000.	1.929	374.
12	15	.552	.290	4250.	227.	1.299	4256.	3.057	392.450	.20322	4278.	1000.	5000.	1.596	311.
12	16	.577	.263	4290.	218.	1.313	4295.	2.915	385.085	.20004	4265.	1000.	5000.	1.305	255.
12	17	.603	.236	4333.	208.	1.328	4338.	2.749	377.232	.19663	4250.	1000.	5000.	1.042	204.
12	18	.631	.207	4382.	195.	1.346	4387.	2.546	368.316	.19275	4233.	1000.	5000.	.792	155.
12	19	.665	.173	4444.	177.	1.368	4447.	2.277	357.312	.18794	4212.	1000.	5000.	.544	107.
12	20	.710	.129	4527.	149.	1.398	4530.	1.889	342.570	.18146	4182.	1000.	5000.	.299	55.
12	21	.771	.072	4651.	102.	1.444	4652.	1.256	321.093	.17192	4138.	1000.	5000.	.088	18.
12	22	.851	0.000	4842.	0.	1.516	4842.	0.000	289.035	.15750	4066.	1000.	5000.	-.005	-1.
13		F =	3832.0	F1D =		3809.0	ETAF =1.0060		ISP =	190.943	ISP1D =		187.899	ETAI =1.0162	
13	1	.000	1.000	4177.	146.	1.272	4179.	2.000	406.852	.20942	4304.	1000.	5000.	20.069	3832.
13	2	.064	.924	4120.	200.	1.252	4124.	2.778	417.250	.21387	4322.	1000.	5000.	17.157	3273.
13	3	.124	.852	4086.	240.	1.241	4093.	3.365	423.297	.21645	4333.	1000.	5000.	14.602	2786.
13	4	.179	.786	4071.	271.	1.237	4080.	3.804	425.791	.21751	4337.	1000.	5000.	12.396	2366.
13	5	.230	.725	4071.	294.	1.237	4081.	4.125	425.465	.21737	4336.	1000.	5000.	10.509	2008.
13	6	.278	.669	4083.	311.	1.242	4094.	4.352	422.960	.21630	4332.	1000.	5000.	8.908	1705.
13	7	.323	.617	4103.	323.	1.249	4116.	4.503	418.827	.21454	4325.	1000.	5000.	7.554	1448.
13	8	.364	.571	4131.	332.	1.259	4144.	4.591	413.523	.21227	4316.	1000.	5000.	6.415	1233.
13	9	.403	.529	4163.	337.	1.271	4176.	4.629	407.416	.20966	4305.	1000.	5000.	5.458	1051.
13	10	.439	.489	4198.	340.	1.283	4211.	4.625	400.797	.20682	4293.	1000.	5000.	4.654	899.
13	11	.473	.454	4235.	340.	1.296	4248.	4.587	393.879	.20384	4281.	1000.	5000.	3.978	770.
13	12	.504	.422	4272.	338.	1.309	4286.	4.524	386.932	.20084	4268.	1000.	5000.	3.413	662.
13	13	.534	.393	4311.	334.	1.323	4324.	4.436	379.803	.19775	4255.	1000.	5000.	2.926	569.
13	14	.562	.365	4351.	329.	1.337	4363.	4.330	372.640	.19463	4241.	1000.	5000.	2.507	489.
13	15	.590	.339	4391.	323.	1.352	4403.	4.206	365.408	.19148	4228.	1000.	5000.	2.141	419.
13	16	.617	.313	4432.	315.	1.367	4444.	4.065	357.987	.18824	4213.	1000.	5000.	1.814	356.
13	17	.645	.287	4477.	305.	1.383	4487.	3.901	350.090	.18477	4198.	1000.	5000.	1.511	298.
13	18	.676	.259	4528.	293.	1.401	4538.	3.699	341.138	.18082	4180.	1000.	5000.	1.217	240.
13	19	.713	.226	4592.	275.	1.424	4600.	3.429	330.097	.17593	4157.	1000.	5000.	.913	181.
13	20	.761	.185	4679.	248.	1.456	4686.	3.034	315.303	.16934	4125.	1000.	5000.	.592	119.
13	21	.828	.129	4809.	199.	1.505	4813.	2.371	293.864	.15969	4077.	1000.	5000.	.277	56.
13	22	.918	.057	5003.	98.	1.579	5004.	1.123	262.972	.14557	4002.	1000.	5000.	.048	10.
13	23	.992	0.000	5162.	0.	1.642	5162.	0.000	238.791	.13433	3938.	1000.	5000.	-.006	-1.
14		F =	3832.1	F1D =		3809.1	ETAF =1.0060		ISP =	190.943	ISP1D =		187.900	ETAI =1.0162	

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
14	1	.001	1.000	4264.	223.	1.304	4270.	3.000	389.830	.20209	4273.	1000.	5000.	20.069	3832.
14	2	.067	.928	4212.	280.	1.287	4221.	3.806	398.893	.20600	4290.	1000.	5000.	17.304	3302.
14	3	.130	.861	4183.	323.	1.277	4196.	4.417	403.758	.20809	4299.	1000.	5000.	14.876	2840.
14	4	.188	.799	4173.	356.	1.275	4188.	4.873	405.240	.20872	4301.	1000.	5000.	12.775	2441.
14	5	.241	.742	4177.	381.	1.277	4194.	5.208	404.075	.20822	4299.	1000.	5000.	10.969	2099.
14	6	.292	.690	4192.	400.	1.283	4211.	5.445	400.893	.20686	4293.	1000.	5000.	9.426	1807.
14	7	.339	.642	4215.	414.	1.292	4236.	5.603	396.227	.20485	4285.	1000.	5000.	8.110	1558.
14	8	.383	.598	4245.	423.	1.303	4266.	5.697	390.509	.20238	4275.	1000.	5000.	6.992	1347.
14	9	.424	.558	4279.	430.	1.315	4301.	5.738	384.088	.19960	4263.	1000.	5000.	6.042	1167.
14	10	.462	.522	4316.	434.	1.328	4338.	5.736	377.234	.19663	4250.	1000.	5000.	5.237	1015.
14	11	.498	.489	4355.	435.	1.342	4377.	5.699	370.147	.19355	4237.	1000.	5000.	4.551	884.
14	12	.531	.459	4394.	434.	1.356	4415.	5.637	363.079	.19046	4223.	1000.	5000.	3.972	774.
14	13	.563	.431	4434.	431.	1.371	4455.	5.550	355.872	.18731	4209.	1000.	5000.	3.466	678.
14	14	.593	.405	4475.	427.	1.386	4495.	5.444	348.662	.18414	4195.	1000.	5000.	3.026	594.
14	15	.622	.380	4517.	421.	1.401	4536.	5.321	341.407	.18094	4180.	1000.	5000.	2.637	519.
14	16	.651	.355	4560.	413.	1.416	4578.	5.180	333.984	.17766	4165.	1000.	5000.	2.285	451.
14	17	.681	.331	4606.	404.	1.433	4623.	5.015	326.105	.17416	4148.	1000.	5000.	1.954	387.
14	18	.714	.304	4659.	392.	1.452	4675.	4.812	317.192	.17018	4129.	1000.	5000.	1.627	324.
14	19	.754	.272	4724.	375.	1.477	4739.	4.539	306.225	.16526	4105.	1000.	5000.	1.281	256.
14	20	.807	.232	4814.	348.	1.510	4827.	4.136	291.571	.15865	4072.	1000.	5000.	.904	182.
14	21	.879	.177	4948.	299.	1.560	4957.	3.455	270.493	.14903	4021.	1000.	5000.	.508	103.
14	22	.976	.107	5146.	199.	1.637	5150.	2.217	240.578	.13516	3943.	1000.	5000.	.169	35.
14	23	1.057	.050	5310.	102.	1.703	5311.	1.099	217.068	.12406	3876.	1000.	5000.	.030	7.
14	24	1.129	0.000	5457.	0.	1.764	5457.	0.000	196.875	.11437	3614.	1000.	5000.	-.007	-1.
15		F =	3832.1	FID =		3809.1	ETAF =1.0060		ISP =	190.945		ISPID =	187.902	ETAI =1.0162	
15	1	.001	1.000	4347.	304.	1.335	4357.	4.000	373.685	.19509	4243.	1000.	5000.	20.069	3832.
15	2	.070	.932	4299.	363.	1.320	4314.	4.830	381.598	.19853	4258.	1000.	5000.	17.433	3324.
15	3	.135	.869	4274.	409.	1.312	4293.	5.461	385.466	.20020	4265.	1000.	5000.	15.114	2887.
15	4	.195	.810	4267.	443.	1.311	4290.	5.933	386.108	.20048	4267.	1000.	5000.	13.102	2506.
15	5	.252	.757	4274.	470.	1.315	4300.	6.279	384.255	.19968	4263.	1000.	5000.	11.366	2178.
15	6	.304	.708	4292.	491.	1.322	4320.	6.524	380.525	.19806	4256.	1000.	5000.	9.873	1895.
15	7	.353	.663	4318.	506.	1.332	4348.	6.688	375.432	.19585	4247.	1000.	5000.	8.593	1655.
15	8	.399	.622	4350.	518.	1.344	4381.	6.785	369.389	.19322	4235.	1000.	5000.	7.495	1448.
15	9	.442	.585	4386.	525.	1.357	4417.	6.828	362.727	.19031	4222.	1000.	5000.	6.556	1271.
15	10	.483	.551	4425.	530.	1.371	4456.	6.827	355.701	.18723	4209.	1000.	5000.	5.752	1118.
15	11	.521	.519	4465.	532.	1.386	4496.	6.791	348.497	.18407	4194.	1000.	5000.	5.062	989.
15	12	.555	.491	4505.	532.	1.401	4536.	6.729	341.356	.18092	4180.	1000.	5000.	4.474	876.
15	13	.589	.464	4547.	529.	1.416	4578.	6.642	334.112	.17771	4165.	1000.	5000.	3.956	777.
15	14	.621	.439	4589.	526.	1.431	4619.	6.535	326.895	.17451	4150.	1000.	5000.	3.501	690.
15	15	.652	.415	4632.	520.	1.447	4661.	6.411	319.656	.17128	4134.	1000.	5000.	3.095	612.
15	16	.683	.392	4676.	514.	1.463	4704.	6.268	312.270	.16798	4118.	1000.	5000.	2.725	541.
15	17	.714	.369	4723.	505.	1.481	4750.	6.102	304.450	.16447	4101.	1000.	5000.	2.373	473.
15	18	.750	.343	4777.	493.	1.501	4803.	5.896	295.626	.16048	4081.	1000.	5000.	2.021	405.
15	19	.792	.312	4845.	477.	1.526	4868.	5.615	284.796	.15557	4056.	1000.	5000.	1.643	331.
15	20	.848	.273	4937.	450.	1.561	4958.	5.209	270.375	.14899	4021.	1000.	5000.	1.221	248.
15	21	.925	.221	5074.	401.	1.613	5089.	4.515	249.775	.13946	3968.	1000.	5000.	.759	156.
15	22	1.030	.152	5275.	302.	1.692	5284.	3.276	220.917	.12589	3888.	1000.	5000.	.330	69.
15	23	1.118	.095	5442.	205.	1.759	5446.	2.156	198.272	.11504	3818.	1000.	5000.	.118	26.
15	24	1.196	.046	5592.	104.	1.822	5593.	1.061	178.954	.10562	3753.	1000.	5000.	.020	5.
15	25	1.269	0.000	5728.	0.	1.882	5728.	0.000	162.270	.09735	3693.	1000.	5000.	-.308	-1.
16		F =	3832.1	FID =		3809.2	ETAF =1.0060		ISP =	190.946		ISPID =	187.904	ETAI =1.0162	
16	1	.001	1.000	4425.	387.	1.366	4442.	5.000	358.305	.18837	4214.	1000.	5000.	20.069	3832.

I	J	X	Y	U	V	W	VMAG	THETA	P	RHO	T	PT	TT	WDOT	F
16	2	.073	.935	4381.	449.	1.352	4404.	5.852	365.206	.19139	4227.	1000.	5000.	17.547	3351.
16	3	.140	.874	4359.	497.	1.346	4387.	6.500	368.210	.19270	4233.	1000.	5000.	15.324	2929.
16	4	.202	.821	4355.	534.	1.346	4388.	6.985	368.134	.19267	4233.	1000.	5000.	13.391	2564.
16	5	.261	.771	4365.	562.	1.351	4401.	7.341	365.702	.19161	4228.	1000.	5000.	11.717	2249.
16	6	.316	.725	4395.	585.	1.359	4424.	7.592	361.518	.18978	4220.	1000.	5000.	10.271	1977.
16	7	.367	.682	4413.	601.	1.370	4454.	7.760	356.075	.18740	4209.	1000.	5000.	9.022	1742.
16	8	.415	.644	4447.	614.	1.383	4489.	7.859	349.773	.18463	4197.	1000.	5000.	7.945	1539.
16	9	.460	.609	4485.	623.	1.397	4528.	7.903	342.927	.18161	4183.	1000.	5000.	7.017	1364.
16	10	.502	.576	4525.	628.	1.412	4568.	7.903	335.777	.17845	4168.	1000.	5000.	6.218	1213.
16	11	.541	.547	4566.	631.	1.428	4610.	7.866	328.499	.17522	4153.	1000.	5000.	5.527	1082.
16	12	.578	.520	4608.	631.	1.443	4651.	7.804	321.322	.17203	4138.	1000.	5000.	4.934	970.
16	13	.613	.494	4651.	630.	1.459	4693.	7.715	314.076	.16879	4122.	1000.	5000.	4.402	870.
16	14	.647	.471	4694.	627.	1.475	4735.	7.607	306.882	.16556	4106.	1000.	5000.	3.943	781.
16	15	.679	.448	4738.	622.	1.491	4778.	7.491	299.689	.16232	4090.	1000.	5000.	3.525	701.
16	16	.712	.426	4783.	616.	1.508	4822.	7.337	292.370	.15901	4073.	1000.	5000.	3.140	627.
16	17	.745	.403	4831.	608.	1.526	4869.	7.169	284.640	.15550	4055.	1000.	5000.	2.772	556.
16	18	.782	.378	4887.	597.	1.547	4923.	6.960	275.938	.15153	4034.	1000.	5000.	2.400	483.
16	19	.827	.349	4956.	580.	1.573	4990.	6.679	265.289	.14664	4008.	1000.	5000.	1.996	405.
16	20	.886	.312	5050.	554.	1.609	5080.	6.261	251.158	.14010	3972.	1000.	5000.	1.538	314.
16	21	.969	.261	5189.	505.	1.663	5214.	5.556	231.104	.13071	3917.	1000.	5000.	1.022	212.
16	22	1.081	.193	5394.	407.	1.744	5409.	4.314	203.307	.11747	3834.	1000.	5000.	.517	109.
16	23	1.175	.138	5564.	310.	1.813	5573.	3.189	181.597	.10692	3763.	1000.	5000.	.242	52.
16	24	1.259	.089	5716.	209.	1.878	5720.	2.094	163.174	.09780	3696.	1000.	5000.	.069	20.
16	25	1.338	.043	5855.	106.	1.939	5856.	1.035	147.310	.08981	3634.	1000.	5000.	.013	4.
16	26	1.413	0.000	5982.	0.	1.997	5982.	0.000	133.381	.08268	3574.	1000.	5000.	-.009	-1.

17 F = 3632.1 FID = 3809.2 ETAF =1.0060 ISP = 190.948 ISPID = 187.907 ETAI =1.0162

I	J	X	Y	U	V	W	VMAG	THETA	P	RHO	T	PT	TT	WDOT	F
17	1	.001	1.000	4499.	473.	1.396	4524.	6.000	343.606	.18191	4185.	1000.	5000.	20.069	3832.
17	2	.075	.939	4458.	537.	1.384	4490.	6.871	349.602	.18455	4197.	1000.	5000.	17.650	3371.
17	3	.145	.882	4439.	587.	1.379	4478.	7.536	351.845	.18554	4201.	1000.	5000.	15.514	2967.
17	4	.209	.830	4438.	626.	1.390	4482.	8.032	351.144	.18523	4200.	1000.	5000.	13.652	2617.
17	5	.270	.783	4450.	657.	1.386	4498.	8.395	348.216	.18394	4194.	1000.	5000.	12.034	2313.
17	6	.326	.740	4472.	680.	1.396	4524.	8.651	343.648	.18193	4185.	1000.	5000.	10.623	2050.
17	7	.379	.700	4502.	699.	1.408	4556.	8.822	337.918	.17940	4173.	1000.	5000.	9.411	1821.
17	8	.429	.664	4537.	712.	1.422	4593.	8.922	331.410	.17652	4159.	1000.	5000.	8.355	1623.
17	9	.476	.630	4576.	722.	1.[illegible]37	4633.	8.967	324.424	.17341	4145.	1000.	5000.	7.439	1451.
17	10	.520	.600	4618.	729.	1.[illegible]32	4675.	8.966	317.190	.17018	4129.	1000.	5000.	6.646	1301.
17	11	.561	.572	4661.	732.	1.468	4718.	8.928	309.873	.16690	4113.	1000.	5000.	5.956	1171.
17	12	.599	.546	4703.	734.	1.485	4760.	8.864	302.691	.16367	4097.	1000.	5000.	5.360	1059.
17	13	.636	.522	4747.	733.	1.501	4803.	8.774	295.470	.16041	4081.	1000.	5000.	4.829	957.
17	14	.671	.500	4791.	730.	1.518	4847.	8.664	288.326	.15717	4064.	1000.	5000.	4.357	867.
17	15	.705	.478	4836.	726.	1.534	4890.	8.536	281.203	.15393	4047.	1000.	5000.	3.930	785.
17	16	.739	.457	4882.	720.	1.552	4935.	8.390	273.974	.15063	4030.	1000.	5000.	3.534	709.
17	17	.774	.435	4932.	712.	1.571	4983.	8.219	266.358	.14713	4011.	1000.	5000.	3.154	636.
17	18	.813	.412	4988.	702.	1.592	5037.	8.007	257.806	.14318	3989.	1000.	5000.	2.766	560.
17	19	.861	.384	5059.	686.	1.619	5105.	7.721	247.368	.13834	3962.	1000.	5000.	2.341	477.
17	20	.923	.348	5155.	660.	1.656	5197.	7.295	233.569	.13187	3924.	1000.	5000.	1.853	381.
17	21	1.010	.298	5296.	611.	1.711	5332.	6.581	214.101	.12265	3867.	1000.	5000.	1.291	269.
17	22	1.129	.233	5504.	514.	1.794	5528.	5.334	187.366	.10975	3782.	1000.	5000.	.729	153.
17	23	1.229	.179	5677.	417.	1.866	5692.	4.204	166.593	.09951	3709.	1000.	5000.	.390	84.
17	24	1.320	.130	5832.	316.	1.932	5840.	3.106	149.070	.09071	3641.	1000.	5000.	.189	42.
17	25	1.405	.085	5972.	214.	1.995	5976.	2.048	134.034	.08302	3577.	1000.	5000.	.070	16.
17	26	1.485	.042	6102.	108.	2.055	6103.	1.014	120.880	.07617	3516.	1000.	5000.	.009	3.
17	27	1.564	0.000	6223.	0.	2.113	6223.	0.000	109.248	.07001	3457.	1000.	5000.	-.010	-1.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
18		F =	3832.2	FID =		3809.3	ETAF	=1.0060	ISP =	190.950	ISPID =		187.911	ETAI	=1.0162
18	1	.001	1.000	4569.	561.	1.426	4604.	7.000	329.525	.17568	4155.	1000.	5000.	20.069	3832.
18	2	.078	.942	4531.	628.	1.415	4574.	7.889	334.702	.17798	4166.	1000.	5000.	17.745	3391.
18	3	.149	.888	4514.	680.	1.411	4565.	8.567	336.264	.17867	4169.	1000.	5000.	15.687	3003.
18	4	.216	.839	4515.	721.	1.414	4572.	9.073	335.014	.17811	4167.	1000.	5000.	13.890	2665.
18	5	.278	.795	4529.	753.	1.421	4592.	9.442	331.655	.17662	4160.	1000.	5000.	12.323	2372.
18	6	.337	.754	4554.	779.	1.432	4620.	9.703	326.761	.17445	4150.	1000.	5000.	10.958	2117.
18	7	.391	.717	4585.	798.	1.444	4654.	9.875	320.794	.17179	4137.	1000.	5000.	9.769	1895.
18	8	.443	.682	4622.	813.	1.459	4693.	9.976	314.122	.16881	4122.	1000.	5000.	8.732	1701.
18	9	.491	.651	4662.	824.	1.475	4735.	10.020	307.035	.16563	4107.	1000.	5000.	7.830	1532.
18	10	.537	.622	4705.	831.	1.491	4778.	10.018	299.751	.16235	4090.	1000.	5000.	7.043	1384.
18	11	.580	.595	4749.	836.	1.508	4822.	9.979	292.424	.15903	4074.	1000.	5000.	6.356	1254.
18	12	.619	.571	4793.	838.	1.525	4865.	9.913	285.263	.15578	4057.	1000.	5000.	5.760	1142.
18	13	.656	.548	4838.	837.	1.542	4909.	9.821	278.092	.15251	4040.	1000.	5000.	5.226	1040.
18	14	.694	.527	4883.	835.	1.559	4953.	9.709	271.019	.14927	4022.	1000.	5000.	4.749	949.
18	15	.730	.506	4928.	832.	1.577	4998.	9.578	263.987	.14604	4005.	1000.	5000.	4.315	866.
18	16	.765	.486	4975.	826.	1.595	5043.	9.429	256.868	.14275	3986.	1000.	5000.	3.911	789.
18	17	.802	.466	5026.	819.	1.614	5092.	9.255	249.385	.13927	3967.	1000.	5000.	3.521	713.
18	18	.843	.443	5083.	809.	1.636	5147.	9.040	241.003	.13536	3944.	1000.	5000.	3.120	636.
18	19	.893	.416	5155.	793.	1.664	5216.	8.749	230.802	.13057	3916.	1000.	5000.	2.678	549.
18	20	.958	.382	5253.	768.	1.702	5309.	8.316	217.362	.12420	3877.	1000.	5000.	2.164	448.
18	21	1.050	.334	5397.	712.	1.759	5444.	7.591	198.507	.11516	3819.	1000.	5000.	1.564	328.
18	22	1.176	.271	5607.	623.	1.884	5642.	6.338	172.831	.10260	3732.	1000.	5000.	.934	200.
18	23	1.282	.218	5782.	527.	1.917	5806.	5.203	152.987	.09269	3657.	1000.	5000.	.556	121.
18	24	1.379	.176	5939.	426.	1.985	5955.	4.103	136.342	.08420	3587.	1000.	5000.	.311	69.
18	25	1.469	.126	6082.	323.	2.049	6091.	3.042	122.122	.07682	3522.	1000.	5000.	.153	35.
18	26	1.556	.083	6214.	218.	2.110	6218.	2.003	105.729	.07027	3460.	1000.	5000.	.056	13.
18	27	1.640	.041	6336.	110.	2.170	6337.	.995	98.809	.06439	3409.	1000.	5000.	.005	2.
18	28	1.723	0.000	6451.	0.	2.228	6451.	0.000	89.107	.05908	3342.	1000.	5000.	-.011	-2.
19		F =	3832.2	FID =		3809.4	ETAF	=1.0060	ISP =	190.952	ISPID =		187.914	ETAI	=1.0162
19	1	.001	1.000	4646.	652.	1.455	4682.	8.000	316.011	.16965	4127.	1000.	5000.	20.069	3832.
19	2	.080	.945	4600.	721.	1.445	4656.	8.905	320.441	.17163	4136.	1000.	5000.	17.832	3409.
19	3	.153	.894	4586.	775.	1.443	4651.	9.595	321.388	.17206	4138.	1000.	5000.	15.847	3036.
19	4	.222	.848	4588.	818.	1.447	4661.	10.110	319.650	.17128	4134.	1000.	5000.	14.110	2711.
19	5	.286	.806	4604.	852.	1.455	4692.	10.484	315.915	.16961	4126.	1000.	5000.	12.591	2427.
19	6	.346	.767	4630.	879.	1.467	4713.	10.747	310.743	.16729	4115.	1000.	5000.	11.262	2180.
19	7	.403	.732	4663.	900.	1.480	4749.	10.921	304.581	.16452	4101.	1000.	5000.	10.100	1963.
19	8	.456	.700	4701.	916.	1.496	4790.	11.022	297.784	.16146	4086.	1000.	5000.	9.084	1774.
19	9	.506	.670	4743.	928.	1.512	4833.	11.065	290.629	.15822	4069.	1000.	5000.	8.194	1602.
19	10	.553	.643	4787.	936.	1.529	4877.	11.061	283.322	.15490	4052.	1000.	5000.	7.416	1462.
19	11	.596	.618	4832.	941.	1.547	4922.	11.020	276.011	.15156	4035.	1000.	5000.	6.733	1334.
19	12	.639	.595	4876.	944.	1.564	4967.	10.952	268.894	.14830	4017.	1000.	5000.	6.138	1221.
19	13	.678	.573	4922.	944.	1.582	5012.	10.857	261.792	.14503	3999.	1000.	5000.	5.603	1120.
19	14	.716	.553	4968.	942.	1.600	5057.	10.742	254.809	.14179	3981.	1000.	5000.	5.122	1028.
19	15	.753	.534	5014.	937.	1.618	5102.	10.609	247.884	.13858	3963.	1000.	5000.	4.683	945.
19	16	.790	.515	5062.	934.	1.636	5149.	10.457	240.891	.13531	3944.	1000.	5000.	4.273	866.
19	17	.829	.495	5114.	927.	1.656	5197.	10.280	233.557	.13187	3924.	1000.	5000.	3.875	789.
19	18	.871	.473	5172.	918.	1.679	5253.	10.060	225.363	.12800	3900.	1000.	5000.	3.463	709.
19	19	.923	.448	5245.	903.	1.708	5322.	9.764	215.416	.12328	3871.	1000.	5000.	3.007	620.
19	20	.992	.415	5345.	879.	1.747	5416.	9.324	202.359	.11702	3831.	1000.	5000.	2.472	515.
19	21	1.088	.369	5491.	829.	1.805	5553.	8.590	184.135	.10817	3771.	1000.	5000.	1.838	388.
19	22	1.221	.309	5704.	734.	1.892	5731.	7.330	159.509	.09597	3682.	1000.	5000.	1.158	249.
19	23	1.334	.256	5881.	638.	1.967	5916.	6.189	140.581	.08638	3605.	1000.	5000.	.736	161.
19	24	1.437	.210	6041.	538.	2.036	6064.	5.086	124.790	.07822	3535.	1000.	5000.	.452	101.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
19	25	1.533	.166	6185.	435.	2.102	6200.	4.023	111.359	.07114	3468.	1000.	5000.	.258	59.
19	26	1.626	.124	6319.	330.	2.165	6327.	2.987	99.703	.06487	3405.	1000.	5000.	.128	30.
19	27	1.716	.083	6443.	222.	2.225	6447.	1.974	89.469	.05928	3344.	1000.	5000.	.047	11.
19	28	1.805	.041	6560.	112.	2.285	6561.	.979	80.411	.05423	3285.	1000.	5000.	.002	1.
19	29	1.893	0.000	6669.	0.	2.343	6669.	0.000	72.340	.04965	3227.	1000.	5000.	-.011	-2.
20		F =	3832.3	FID =		3809.4	ETAF =1.0060		ISP =	190.955	ISPID =		187.919	ETAI =1.0162	
20	1	.002	1.000	4700.	744.	1.484	4758.	9.000	303.024	.16382	4098.	1000.	5000.	20.069	3832.
20	2	.082	.948	4665.	816.	1.475	4736.	9.920	306.766	.16551	4106.	1000.	5000.	17.913	3425.
20	3	.158	.900	4653.	872.	1.475	4734.	10.621	307.156	.16568	4107.	1000.	5000.	15.996	3066.
20	4	.228	.856	4657.	917.	1.479	4747.	11.142	304.981	.16470	4102.	1000.	5000.	14.314	2753.
20	5	.294	.817	4675.	953.	1.489	4771.	11.521	300.917	.16287	4093.	1000.	5000.	12.840	2479.
20	6	.356	.780	4702.	981.	1.501	4803.	11.786	295.503	.16043	4081.	1000.	5000.	11.546	2235.
20	7	.414	.747	4736.	1003.	1.516	4841.	11.960	289.188	.15757	4066.	1000.	5000.	10.411	2028.
20	8	.469	.717	4776.	1020.	1.532	4884.	12.060	282.298	.15443	4050.	1000.	5000.	9.413	1843.
20	9	.521	.689	4818.	1033.	1.549	4928.	12.102	275.102	.15114	4032.	1000.	5000.	8.538	1680.
20	10	.569	.665	4863.	1042.	1.567	4974.	12.096	267.799	.14779	4014.	1000.	5000.	7.768	1536.
20	11	.615	.643	4909.	1048.	1.585	5020.	12.052	260.525	.14444	3996.	1000.	5000.	7.090	1409.
20	12	.658	.618	4955.	1051.	1.603	5065.	11.981	253.471	.14117	3978.	1000.	5000.	6.497	1295.
20	13	.699	.598	5002.	1052.	1.621	5111.	11.884	246.457	.13791	3959.	1000.	5000.	5.962	1196.
20	14	.738	.578	5048.	1052.	1.640	5157.	11.766	239.580	.13470	3940.	1000.	5000.	5.479	1105.
20	15	.777	.560	5095.	1047.	1.658	5202.	11.630	232.777	.13150	3922.	1000.	5000.	5.037	1021.
20	16	.815	.542	5144.	1044.	1.677	5249.	11.475	225.923	.12827	3902.	1000.	5000.	4.622	941.
20	17	.855	.523	5196.	1038.	1.698	5299.	11.294	218.752	.12486	3881.	1000.	5000.	4.217	863.
20	18	.892	.503	5256.	1028.	1.721	5355.	11.071	210.758	.12105	3857.	1000.	5000.	3.797	782.
20	19	.953	.478	5330.	1014.	1.751	5425.	10.769	201.081	.11640	3827.	1000.	5000.	3.329	690.
20	20	1.025	.447	5431.	989.	1.791	5520.	10.322	188.419	.11026	3786.	1000.	5000.	2.776	592.
20	21	1.125	.423	5579.	941.	1.851	5658.	9.578	170.840	.10162	3725.	1000.	5000.	2.113	449.
20	22	1.266	.349	5795.	847.	1.939	5856.	8.311	147.254	.08978	3633.	1000.	5000.	1.388	301.
20	23	1.385	.294	5975.	751.	2.016	6022.	7.164	129.225	.08053	3555.	1000.	5000.	.926	204.
20	24	1.493	.249	6136.	651.	2.087	6170.	6.057	114.262	.07268	3483.	1000.	5000.	.607	136.
20	25	1.596	.206	6282.	549.	2.154	6306.	4.991	101.592	.06590	3415.	1000.	5000.	.380	87.
20	26	1.695	.165	6417.	443.	2.218	6433.	3.953	90.641	.05992	3351.	1000.	5000.	.220	51.
20	27	1.791	.124	6544.	336.	2.280	6552.	2.939	81.064	.05460	3289.	1000.	5000.	.110	26.
20	28	1.887	.083	6662.	226.	2.341	6666.	1.944	72.616	.04981	3230.	1000.	5000.	.039	10.
20	29	1.982	.042	6773.	114.	2.401	6774.	.965	65.119	.04549	3171.	1000.	5000.	.000	1.
20	30	2.077	0.000	6879.	0.	2.460	6879.	0.000	58.428	.04156	3115.	1000.	5000.	-.012	-2.
21		F =	3832.3	FID =		3809.5	ETAF =1.0060		ISP =	190.957	ISPID =		187.923	ETAI =1.0161	
21	1	.002	1.000	4760.	839.	1.512	4833.	10.000	290.529	.15817	4069.	1000.	5000.	20.069	3832.
21	2	.084	.951	4727.	913.	1.505	4815.	10.933	293.637	.15958	4076.	1000.	5000.	17.989	3441.
21	3	.162	.905	4716.	972.	1.506	4815.	11.644	293.518	.15953	4076.	1000.	5000.	16.135	3095.
21	4	.234	.864	4722.	1019.	1.512	4831.	12.172	290.951	.15837	4070.	1000.	5000.	14.506	2793.
21	5	.302	.827	4741.	1056.	1.522	4857.	12.554	286.599	.15639	4060.	1000.	5000.	13.074	2528.
21	6	.365	.793	4770.	1085.	1.535	4892.	12.820	280.990	.15383	4047.	1000.	5000.	11.813	2295.
21	7	.425	.762	4805.	1109.	1.551	4931.	12.993	274.543	.15089	4031.	1000.	5000.	10.703	2090.
21	8	.481	.733	4846.	1127.	1.568	4975.	13.092	267.587	.14770	4014.	1000.	5000.	9.725	1909.
21	9	.535	.707	4890.	1141.	1.586	5021.	13.132	260.376	.14437	3995.	1000.	5000.	8.862	1749.
21	10	.585	.683	4935.	1151.	1.604	5068.	13.123	253.098	.14100	3977.	1000.	5000.	8.102	1607.
21	11	.632	.660	4982.	1157.	1.623	5115.	13.077	245.882	.13764	3958.	1000.	5000.	7.430	1482.
21	12	.676	.640	5029.	1161.	1.642	5161.	13.003	238.909	.13438	3939.	1000.	5000.	6.840	1371.
21	13	.718	.621	5076.	1163.	1.660	5208.	12.902	231.997	.13113	3919.	1000.	5000.	6.306	1270.
21	14	.759	.603	5124.	1162.	1.679	5254.	12.781	225.239	.12794	3900.	1000.	5000.	5.822	1179.
21	15	.799	.585	5172.	1160.	1.698	5300.	12.642	218.570	.12478	3881.	1000.	5000.	5.377	1094.

I	J	X	Y	U	V	W	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
21	16	.839	.566	5221.	1156.	1.718	5347.	12.484	211.867	.12158	3861.	1000.	5000.	4.959	1014.
21	17	.880	.551	5274.	1150.	1.739	5398.	12.299	204.870	.11823	3839.	1000.	5000.	4.549	936.
21	18	.926	.532	5334.	1141.	1.763	5455.	12.072	197.088	.11447	3814.	1000.	5000.	4.123	853.
21	19	.983	.508	5410.	1127.	1.793	5526.	11.765	187.691	.10990	3783.	1000.	5000.	3.645	760.
21	20	1.057	.478	5512.	1102.	1.834	5621.	11.310	175.438	.10389	3741.	1000.	5000.	3.077	648.
21	21	1.162	.437	5662.	1055.	1.896	5759.	10.557	158.508	.09547	3678.	1000.	5000.	2.388	510.
21	22	1.310	.380	5860.	961.	1.986	5958.	9.282	135.950	.08400	3585.	1000.	5000.	1.622	354.
21	23	1.435	.332	6062.	866.	2.065	6124.	8.129	118.800	.07507	3506.	1000.	5000.	1.126	250.
21	24	1.550	.288	6225.	766.	2.137	6272.	7.017	104.639	.06754	3432.	1000.	5000.	.773	174.
21	25	1.659	.247	6374.	664.	2.206	6408.	5.948	92.700	.06105	3364.	1000.	5000.	.516	118.
21	26	1.764	.206	6511.	559.	2.271	6535.	4.908	82.423	.05536	3298.	1000.	5000.	.328	76.
21	27	1.867	.166	6638.	452.	2.335	6654.	3.892	73.470	.05030	3236.	1000.	5000.	.191	45.
21	28	1.969	.126	6758.	342.	2.397	6767.	2.896	65.601	.04577	3175.	1000.	5000.	.095	23.
21	29	2.070	.085	6871.	230.	2.458	6875.	1.917	58.642	.04169	3117.	1000.	5000.	.033	9.
21	30	2.172	.043	6978.	116.	2.519	6979.	.952	52.457	.03799	3059.	1000.	5000.	-.002	1.
21	31	2.275	0.000	7079.	0.	2.579	7079.	0.000	46.934	.03462	3003.	1000.	5000.	-.013	-2.

22 F = 3832.4 FID = 3809.6 ETAF =1.0060 ISP = 190.960 ISPID = 187.929 ETAI =1.0161

I	J	X	Y	U	V	W	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
22	1	.002	1.000	4617.	936.	1.541	4907.	11.000	278.499	.15270	4041.	1000.	5000.	20.069	3832.
22	2	.086	.953	4785.	1012.	1.535	4891.	11.945	281.019	.15385	4047.	1000.	5000.	18.060	3456.
22	3	.166	.910	4776.	1073.	1.536	4895.	12.665	280.434	.15358	4045.	1000.	5000.	16.266	3123.
22	4	.240	.872	4783.	1122.	1.543	4913.	13.198	277.514	.15225	4038.	1000.	5000.	14.686	2851.
22	5	.309	.837	4803.	1161.	1.554	4942.	13.582	272.909	.15014	4027.	1000.	5000.	13.294	2575.
22	6	.374	.835	4833.	1192.	1.569	4978.	13.849	267.131	.14749	4013.	1000.	5000.	12.065	2349.
22	7	.435	.776	4870.	1216.	1.585	5019.	14.022	260.587	.14447	3996.	1000.	5000.	10.980	2149.
22	8	.493	.749	4912.	1235.	1.603	5064.	14.119	253.591	.14123	3978.	1000.	5000.	10.020	1972.
22	9	.548	.724	4956.	1250.	1.622	5112.	14.156	246.388	.13788	3959.	1000.	5000.	9.171	1815.
22	10	.600	.702	5003.	1261.	1.641	5159.	14.144	239.155	.13450	3939.	1000.	5000.	8.421	1676.
22	11	.648	.681	5051.	1268.	1.660	5207.	14.095	232.013	.13114	3919.	1000.	5000.	7.755	1552.
22	12	.694	.662	5098.	1273.	1.680	5255.	14.017	225.135	.12789	3900.	1000.	5000.	7.169	1442.
22	13	.738	.644	5146.	1275.	1.699	5302.	13.913	218.340	.12467	3880.	1000.	5000.	6.636	1342.
22	14	.780	.627	5194.	1275.	1.718	5349.	13.789	211.712	.12151	3860.	1000.	5000.	6.153	1251.
22	15	.821	.611	5243.	1273.	1.738	5396.	13.647	205.188	.11838	3840.	1000.	5000.	5.707	1166.
22	16	.862	.594	5293.	1269.	1.758	5443.	13.485	198.646	.11522	3819.	1000.	5000.	5.286	1086.
22	17	.905	.578	5347.	1264.	1.790	5494.	13.296	191.831	.11192	3797.	1000.	5000.	4.873	1007.
22	18	.953	.560	5408.	1255.	1.805	5552.	13.064	184.269	.10823	3772.	1000.	5000.	4.441	923.
22	19	1.011	.538	5484.	1241.	1.835	5623.	12.752	175.163	.10376	3740.	1000.	5000.	3.955	828.
22	20	1.089	.510	5558.	1237.	1.878	5719.	12.290	163.325	.09788	3697.	1000.	5000.	3.373	714.
22	21	1.199	.475	5740.	1171.	1.940	5858.	11.528	147.048	.08968	3633.	1000.	5000.	2.662	572.
22	22	1.353	.416	5961.	1077.	2.033	6057.	10.244	125.501	.07859	3538.	1000.	5000.	1.861	408.
22	23	1.485	.370	6145.	983.	2.113	6223.	9.084	105.209	.06999	3457.	1000.	5000.	1.332	297.
22	24	1.406	.324	6310.	983.	2.187	6372.	7.968	95.823	.06276	3382.	1000.	5000.	.949	215.
22	25	1.722	.288	6460.	791.	2.257	6507.	6.895	84.587	.05657	3313.	1000.	5000.	.664	153.
22	26	1.833	.248	6599.	676.	2.324	6633.	5.853	74.533	.05115	3247.	1000.	5000.	.450	105.
22	27	1.942	.209	6728.	569.	2.389	6752.	4.836	66.591	.04634	3183.	1000.	5000.	.288	68.
22	28	2.051	.169	6850.	460.	2.453	6865.	3.838	59.269	.04206	3122.	1000.	5000.	.169	41.
22	29	2.160	.129	6964.	345.	2.515	6973.	2.856	52.816	.03820	3063.	1000.	5000.	.084	21.
22	30	2.269	.087	7072.	234.	2.577	7074.	1.895	47.100	.03473	3005.	1000.	5000.	.028	8.
22	31	2.380	.044	7175.	118.	2.638	7176.	.941	42.019	.03158	2948.	1000.	5000.	-.004	0.
22	32	2.492	0.000	7272.	0.	2.699	7272.	0.000	37.483	.02871	2893.	1000.	5000.	-.014	-2.

23 F = 3832.4 FID = 3808.8 ETAF =1.0060 ISP = 190.963 ISPID = 187.534 ETAI =1.0161

I	J	X	Y	U	V	W	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
23	1	.202	1.003	4471.	1035.	1.569	4979.	12.000	266.909	.14738	4012.	1000.	5000.	20.069	3832.
23	2	.388	.956	4840.	1114.	1.564	4967.	12.956	268.881	.14829	4017.	1000.	5000.	18.128	3471.

I	J	X	Y	U	V	W	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
23	3	.164	.916	6832.	1176.	1.567	4973.	15.684	267.868	.14782	4014.	1000.	5000.	16.389	3149.
23	4	.245	.879	4841.	1227.	1.575	4994.	14.221	264.632	.14633	4006.	1000.	5000.	14.856	2867.
23	5	.316	.847	4862.	1267.	1.587	5024.	14.607	259.806	.14411	3994.	1000.	5000.	13.502	2619.
23	6	.383	.817	4893.	1309.	1.602	5063.	14.874	253.889	.14137	3979.	1000.	5000.	12.304	2400.
23	7	.446	.799	4931.	1325.	1.619	5106.	15.045	247.272	.13829	3961.	1000.	5000.	11.243	2205.
23	8	.505	.765	4973.	1346.	1.638	5152.	15.140	240.259	.13501	3942.	1000.	5000.	10.301	2032.
23	9	.561	.742	5019.	1361.	1.657	5200.	15.174	233.083	.13165	3922.	1000.	5000.	9.467	1878.
23	10	.614	.721	5067.	1373.	1.677	5249.	15.159	225.913	.12826	3902.	1000.	5000.	8.726	1742.
23	11	.665	.701	5115.	1381.	1.698	5298.	15.106	218.861	.12492	3881.	1000.	5000.	8.067	1620.
23	12	.711	.683	5163.	1386.	1.717	5346.	15.025	212.092	.12169	3861.	1000.	5000.	7.485	1511.
23	13	.757	.666	5212.	1389.	1.737	5394.	14.918	205.424	.11849	3841.	1000.	5000.	6.955	1412.
23	14	.800	.651	5261.	1389.	1.757	5441.	14.790	198.938	.11537	3820.	1000.	5000.	6.472	1321.
23	15	.847	.635	5310.	1388.	1.777	5489.	14.644	192.568	.11228	3800.	1000.	5000.	6.026	1236.
23	16	.885	.620	5361.	1384.	1.798	5537.	14.478	186.194	.10917	3778.	1000.	5000.	5.604	1156.
23	17	.932	.605	5416.	1379.	1.820	5598.	14.286	179.569	.10593	3756.	1000.	5000.	5.188	1076.
23	18	.979	.588	5478.	1371.	1.846	5646.	14.049	172.234	.10231	3730.	1000.	5000.	4.751	992.
23	19	1.040	.567	5555.	1357.	1.877	5718.	13.732	163.424	.09793	3697.	1000.	5000.	4.259	896.
23	20	1.121	.541	5660.	1334.	1.921	5815.	13.262	152.008	.09219	3653.	1000.	5000.	3.666	781.
23	21	1.235	.504	5813.	1284.	1.984	5954.	12.490	136.383	.08423	3587.	1000.	5000.	2.936	634.
23	22	1.396	.452	6037.	1195.	2.079	6154.	11.198	115.829	.07351	3491.	1000.	5000.	2.102	464.
23	23	1.535	.409	6223.	1101.	2.141	6320.	10.031	100.371	.06524	3409.	1000.	5000.	1.543	346.
23	24	1.663	.366	6390.	1002.	2.236	6468.	8.910	87.734	.05832	3333.	1000.	5000.	1.133	258.
23	25	1.784	.329	6542.	900.	2.308	6603.	7.834	77.171	.05240	3262.	1000.	5000.	.823	190.
23	26	1.903	.291	6682.	796.	2.376	6739.	6.789	68.150	.04725	3196.	1000.	5000.	.583	137.
23	27	2.019	.252	6813.	688.	2.443	6848.	5.770	60.349	.04269	3131.	1000.	5000.	.339	95.
23	28	2.135	.214	6936.	579.	2.508	6960.	4.771	53.543	.03864	3070.	1000.	5000.	.257	62.
23	29	2.251	.174	7052.	467.	2.572	7067.	3.790	47.564	.03501	3010.	1000.	5000.	.151	37.
23	30	2.367	.133	7162.	353.	2.635	7170.	2.824	42.287	.03174	2951.	1000.	5000.	.075	14.
23	31	2.486	.093	7266.	237.	2.697	7270.	1.872	37.613	.02879	2894.	1000.	5000.	.024	7.
23	32	2.607	.046	7365.	120.	2.760	7365.	.931	33.458	.02612	2838.	1000.	5000.	-.005	-0.
23	33	2.730	0.000	7459.	0.	2.822	7459.	0.000	29.752	.02368	2783.	1000.	5000.	-.014	-2.

24 F = 3832.5 FID = 3809.9 ETAF =1.0059 ISP = 190.965 ISP10 = 187.940 ETAI =1.0161

I	J	X	Y	U	V	W	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
24	1	.002	1.000	4921.	1176.	1.597	5051.	13.000	255.739	.14222	3984.	1000.	5000.	20.069	3832.
24	2	.090	.959	4892.	1217.	1.584	5041.	13.966	257.200	.14290	3987.	1000.	5000.	18.192	3484.
24	3	.173	.921	4885.	1282.	1.597	5050.	14.701	255.794	.14225	3984.	1000.	5000.	16.507	3174.
24	4	.251	.887	4895.	1334.	1.606	5075.	15.241	252.273	.14062	3974.	1000.	5000.	15.028	2902.
24	5	.323	.856	4917.	1376.	1.619	5106.	15.629	247.255	.13828	3961.	1000.	5000.	13.701	2662.
24	6	.391	.828	4949.	1402.	1.635	5146.	15.895	241.224	.13547	3945.	1000.	5000.	12.532	2449.
24	7	.456	.803	4988.	1436.	1.653	5190.	16.064	234.559	.13234	3927.	1000.	5000.	11.494	2259.
24	8	.517	.780	5031.	1457.	1.673	5238.	16.156	227.550	.12904	3907.	1000.	5000.	10.571	2091.
24	9	.575	.759	5078.	1474.	1.693	5287.	16.186	220.419	.12566	3886.	1000.	5000.	9.750	1940.
24	10	.629	.739	5126.	1486.	1.714	5337.	16.168	213.327	.12228	3865.	1000.	5000.	9.019	1806.
24	11	.680	.721	5175.	1495.	1.734	5387.	16.111	206.379	.11895	3844.	1000.	5000.	8.367	1685.
24	12	.729	.704	5224.	1501.	1.755	5435.	16.027	199.730	.11575	3823.	1000.	5000.	7.791	1578.
24	13	.775	.689	5274.	1504.	1.775	5484.	15.916	193.200	.11259	3802.	1000.	5000.	7.263	1480.
24	14	.820	.674	5323.	1505.	1.796	5532.	15.784	186.863	.10950	3781.	1000.	5000.	6.782	1389.
24	15	.864	.660	5373.	1504.	1.817	5580.	15.635	180.655	.10646	3759.	1000.	5000.	6.336	1305.
24	16	.908	.646	5425.	1501.	1.838	5629.	15.465	174.456	.10341	3738.	1000.	5000.	5.913	1225.
24	17	.954	.632	5480.	1496.	1.861	5680.	15.269	168.027	.10022	3714.	1000.	5000.	5.495	1145.
24	18	1.005	.616	5543.	1488.	1.887	5739.	15.028	160.924	.09668	3688.	1000.	5000.	5.056	1060.
24	19	1.068	.597	5621.	1475.	1.919	5811.	14.704	152.415	.09240	3654.	1000.	5000.	4.557	964.
24	20	1.152	.572	5727.	1452.	1.963	5908.	14.228	141.423	.08681	3609.	1000.	5000.	3.955	845.
24	21	1.271	.537	5882.	1406.	2.029	6048.	13.446	126.446	.07908	3542.	1000.	5000.	3.208	696.
24	22	1.449	.489	6108.	1314.	2.125	6248.	12.144	106.865	.06873	3444.	1000.	5000.	2.345	520.

I	J	X	Y	U	V	W	VMAG	THETA	P	RHO	T	PT	TT	WDOT	F
24	23	1.585	.447	6297.	1221.	2.209	6414.	10.971	92.219	.06079	3361.	1000.	5000.	1.760	397.
24	24	1.719	.409	6465.	1122.	2.286	6562.	9.845	80.303	.05417	3284.	1000.	5000.	1.324	303.
24	25	1.848	.371	6619.	1021.	2.359	6697.	8.765	70.384	.04853	3213.	1000.	5000.	.990	230.
24	26	1.973	.334	6761.	916.	2.428	6823.	7.717	61.947	.04363	3145.	1000.	5000.	.727	171.
24	27	2.096	.297	6893.	809.	2.496	6941.	6.696	54.677	.03932	3080.	1000.	5000.	.521	124.
24	28	2.219	.259	7018.	700.	2.563	7053.	5.695	48.357	.03550	3018.	1000.	5000.	.358	86.
24	29	2.343	.221	7135.	588.	2.628	7160.	4.713	42.824	.03208	2957.	1000.	5000.	.232	57.
24	30	2.468	.180	7246.	474.	2.693	7262.	3.746	37.957	.02901	2899.	1000.	5000.	.136	34.
24	31	2.595	.138	7352.	359.	2.757	7361.	2.793	33.659	.02625	2841.	1000.	5000.	.067	17.
24	32	2.724	.095	7452.	241.	2.820	7456.	1.852	29.853	.02375	2785.	1000.	5000.	.020	6.
24	33	2.857	.048	7547.	121.	2.884	7548.	.921	26.474	.02149	2730.	1000.	5000.	-.007	-0.
24	34	2.993	0.000	7638.	0.	2.948	7638.	0.000	23.463	.01943	2675.	1000.	5000.	-.015	-2.
25		F =	3832.6	FID =		3810.0	ETAF =1.0059		ISP =	190.968	ISPID =		187.947	ETAI =1.0161	
25	1	.002	1.000	4969.	1259.	1.625	5121.	14.000	244.969	.13722	3955.	1000.	5000.	20.069	3833.
25	2	.092	.961	4941.	1322.	1.623	5114.	14.975	245.954	.13768	3958.	1000.	5000.	18.252	3497.
25	3	.177	.926	4934.	1389.	1.627	5126.	15.716	244.186	.13685	3953.	1000.	5000.	16.619	3198.
25	4	.256	.894	4945.	1442.	1.638	5151.	16.259	240.409	.13508	3943.	1000.	5000.	15.173	2935.
25	5	.333	.866	4968.	1486.	1.652	5186.	16.647	235.226	.13265	3928.	1000.	5000.	13.890	2702.
25	6	.400	.840	5001.	1521.	1.668	5227.	16.912	229.106	.12977	3911.	1000.	5000.	12.750	2496.
25	7	.466	.817	5041.	1549.	1.687	5273.	17.078	222.412	.12660	3892.	1000.	5000.	11.734	2311.
25	8	.528	.795	5085.	1571.	1.708	5322.	17.167	215.425	.12328	3871.	1000.	5000.	10.829	2147.
25	9	.588	.775	5133.	1588.	1.728	5373.	17.194	208.357	.11990	3850.	1000.	5000.	10.022	1999.
25	10	.643	.757	5182.	1601.	1.750	5423.	17.172	201.357	.11653	3828.	1000.	5000.	9.301	1867.
25	11	.696	.741	5232.	1611.	1.771	5474.	17.111	194.525	.11323	3806.	1000.	5000.	8.657	1749.
25	12	.746	.726	5281.	1617.	1.792	5523.	17.023	188.007	.11006	3784.	1000.	5000.	8.086	1643.
25	13	.794	.711	5331.	1621.	1.813	5572.	16.906	181.623	.10694	3763.	1000.	5000.	7.562	1546.
25	14	.840	.697	5382.	1622.	1.834	5621.	16.773	175.444	.10389	3741.	1000.	5000.	7.083	1456.
25	15	.885	.684	5432.	1621.	1.856	5669.	16.619	169.404	.10091	3719.	1000.	5000.	6.638	1372.
25	16	.931	.672	5485.	1619.	1.877	5719.	16.446	163.385	.09791	3697.	1000.	5000.	6.215	1292.
25	17	.978	.655	5542.	1614.	1.901	5772.	16.245	157.156	.09479	3673.	1000.	5000.	5.795	1212.
25	18	1.031	.644	5604.	1607.	1.927	5830.	16.000	150.290	.09132	3646.	1000.	5000.	5.353	1127.
25	19	1.096	.626	5683.	1594.	1.960	5902.	15.671	142.083	.08715	3612.	1000.	5000.	4.851	1030.
25	20	1.183	.601	5790.	1572.	2.006	6000.	15.186	131.517	.08171	3566.	1000.	5000.	4.241	910.
25	21	1.307	.571	5947.	1527.	2.072	6140.	14.395	117.182	.07422	3498.	1000.	5000.	3.479	759.
25	22	1.483	.526	6176.	1454.	2.171	6340.	13.084	98.552	.06425	3398.	1000.	5000.	2.590	577.
25	23	1.635	.487	6366.	1342.	2.256	6506.	11.904	84.692	.05663	3313.	1000.	5000.	1.980	449.
25	24	1.777	.452	6537.	1244.	2.335	6654.	10.773	73.470	.05030	3236.	1000.	5000.	1.521	350.
25	25	1.912	.415	6692.	1143.	2.409	6789.	9.689	64.167	.04493	3164.	1000.	5000.	1.164	271.
25	26	2.044	.379	6835.	1038.	2.481	6914.	8.638	56.285	.04028	3095.	1000.	5000.	.880	209.
25	27	2.174	.343	6969.	932.	2.550	7031.	7.619	49.518	.03621	3030.	1000.	5000.	.653	156.
25	28	2.305	.307	7095.	822.	2.618	7143.	6.612	43.656	.03260	2967.	1000.	5000.	.471	114.
25	29	2.437	.269	7214.	711.	2.684	7249.	5.628	38.541	.02938	2906.	1000.	5000.	.326	80.
25	30	2.570	.232	7327.	597.	2.750	7351.	4.660	34.057	.02650	2847.	1000.	5000.	.211	53.
25	31	2.705	.188	7434.	482.	2.816	7449.	3.706	30.110	.02392	2789.	1000.	5000.	.124	32.
25	32	2.844	.145	7535.	364.	2.881	7544.	2.765	26.625	.02159	2732.	1000.	5000.	.060	16.
25	33	2.986	.100	7632.	244.	2.946	7636.	1.834	23.543	.01948	2677.	1000.	5000.	.017	6.
25	34	3.133	.051	7724.	123.	3.011	7725.	.912	20.810	.01758	2622.	1000.	5000.	-.008	-1.
25	35	3.284	0.000	7811.	0.	3.077	7811.	0.000	18.379	.01585	2569.	1000.	5000.	-.016	-3.
26		F =	3832.8	FID =		3810.2	ETAF =1.0059		ISP =	190.972	ISPID =		187.954	ETAI =1.0161	
26	1	.003	1.000	5013.	1343.	1.653	5190.	15.000	234.583	.13235	3927.	1000.	5000.	20.069	3833.
26	2	.094	.964	4986.	1428.	1.652	5196.	15.984	235.124	.13260	3928.	1000.	5000.	18.310	3510.
26	3	.181	.931	4981.	1497.	1.658	5201.	16.730	233.022	.13162	3922.	1000.	5000.	16.725	3221.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
26	4	.261	.902	4992.	1552.	1.669	5228.	17.275	229.016	.12973	3911.	1000.	5000.	15.320	2967.
26	5	.337	.875	5016.	1597.	1.684	5254.	17.662	223.692	.12721	3896.	1000.	5000.	14.071	2742.
26	6	.408	.852	5050.	1634.	1.701	5308.	17.925	217.505	.12427	3877.	1000.	5000.	12.959	2541.
26	7	.476	.830	5092.	1663.	1.721	5355.	18.089	210.803	.12107	3857.	1000.	5000.	11.965	2362.
26	8	.540	.810	5136.	1686.	1.742	5405.	18.175	203.856	.11774	3836.	1000.	5000.	11.077	2201.
26	9	.600	.792	5184.	1709.	1.764	5457.	18.198	196.863	.11436	3814.	1000.	5000.	10.284	2057.
26	10	.658	.776	5234.	1718.	1.786	5508.	18.172	189.969	.11101	3791.	1000.	5000.	9.574	1927.
26	11	.712	.760	5284.	1728.	1.808	5560.	18.107	183.263	.10774	3768.	1000.	5000.	8.937	1811.
26	12	.763	.746	5335.	1735.	1.829	5609.	18.014	176.885	.10461	3746.	1000.	5000.	8.372	1707.
26	13	.812	.733	5385.	1739.	1.851	5659.	17.895	170.655	.10153	3724.	1000.	5000.	7.852	1610.
26	14	.860	.721	5436.	1741.	1.873	5708.	17.756	164.639	.09854	3702.	1000.	5000.	7.376	1521.
26	15	.906	.709	5488.	1741.	1.895	5757.	17.598	158.772	.09560	3679.	1000.	5000.	6.932	1438.
26	16	.953	.697	5540.	1739.	1.917	5807.	17.421	152.939	.09266	3656.	1000.	5000.	6.509	1358.
26	17	1.002	.685	5597.	1734.	1.941	5859.	17.216	146.913	.08961	3632.	1000.	5000.	6.099	1279.
26	18	1.057	.672	5661.	1727.	1.968	5909.	16.966	140.286	.08623	3604.	1000.	5000.	5.646	1194.
26	19	1.124	.654	5741.	1715.	2.002	5992.	16.631	132.384	.08216	3570.	1000.	5000.	5.139	1096.
26	20	1.214	.634	5849.	1693.	2.048	6069.	16.139	122.242	.07688	3522.	1000.	5000.	4.523	975.
26	21	1.343	.605	6008.	1648.	2.116	6230.	15.334	108.541	.06963	3453.	1000.	5000.	3.748	821.
26	22	1.526	.563	6239.	1558.	2.217	6430.	14.018	90.939	.06003	3352.	1000.	5000.	2.836	635.
26	23	1.686	.522	6431.	1465.	2.308	6596.	12.830	77.740	.05272	3266.	1000.	5000.	2.204	502.
26	24	1.854	.482	6603.	1367.	2.384	6745.	11.634	67.184	.04669	3188.	1000.	5000.	1.723	398.
26	25	1.977	.459	6760.	1266.	2.460	6878.	10.606	58.470	.04158	3115.	1000.	5000.	1.345	315.
26	26	2.116	.425	6906.	1162.	2.555	7005.	9.552	51.114	.03718	3046.	1000.	5000.	1.041	247.
26	27	2.254	.391	7041.	1056.	2.614	7120.	8.525	44.823	.03332	2980.	1000.	5000.	.795	190.
26	28	2.393	.356	7169.	946.	2.673	7231.	7.521	39.331	.02992	2917.	1000.	5000.	.594	144.
26	29	2.532	.317	7289.	836.	2.741	7337.	6.536	34.669	.02690	2855.	1000.	5000.	.430	105.
26	30	2.674	.281	7403.	727.	2.808	7439.	5.567	30.541	.02420	2795.	1000.	5000.	.298	74.
26	31	2.819	.241	7511.	606.	2.875	7536.	4.612	26.920	.02179	2737.	1000.	5000.	.154	49.
26	32	2.968	.196	7614.	488.	2.942	7630.	3.673	23.734	.01962	2680.	1000.	5000.	.114	29.
26	33	3.120	.153	7712.	369.	3.008	7721.	2.738	20.924	.01766	2625.	1000.	5000.	.054	15.
26	34	3.278	.105	7805.	248.	3.075	7809.	1.817	18.442	.01590	2570.	1000.	5000.	.014	5.
26	35	3.440	.054	7898.	125.	3.142	7895.	.904	16.245	.01430	2516.	1000.	5000.	-.009	-1.
26	36	3.609	0.000	7979.	0.	3.209	7979.	0.000	14.294	.01286	2463.	1000.	5000.	-.017	-3.

IRROTATIONAL FLOWFIELD ALONG LEFT-RUNNING CHARACTERISTICS EMANATING FROM THE KERNEL RIGHT-RUNNING CHARACTERISTIC.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
26	1	.083	1.000	5033.	1345.	1.653	5190.	15.000	234.583	.13235	3927.	1000.	5000.	20.069	3833.
26	2	.094	.964	4986.	1428.	1.652	5186.	15.984	235.124	.13260	3928.	1000.	5000.	18.310	3510.
27	2	.153	1.041	5004.	1341.	1.649	5180.	15.000	236.064	.13305	3931.	1000.	5000.	20.069	3889.
27		F =	3889.5	FID =		3918.7	ETAF = .9925		ISP =	193.804		ISPID =	193.310	ETAI =1.0026	
26	3	.141	.931	4981.	1497.	1.658	5201.	16.730	233.022	.13162	3922.	1000.	5000.	16.725	3221.
27	3	.237	1.007	4999.	1461.	1.654	5191.	15.654	234.410	.13227	3926.	1000.	5000.	18.376	3578.
28	3	.292	1.074	5023.	1346.	1.658	5201.	15.000	233.036	.13162	3922.	1000.	5000.	20.069	3944.
28		F =	3944.0	FID =		4000.9	ETAF = .9858		ISP =	196.523		ISPID =	197.565	ETAI = .9957	
26	4	.261	.902	4992.	1552.	1.669	5228.	17.275	229.016	.12973	3911.	1000.	5000.	15.320	2967.
27	4	.316	.976	5010.	1488.	1.664	5215.	16.117	230.896	.13061	3916.	1000.	5000.	16.863	3301.
28	4	.370	1.047	5035.	1387.	1.666	5222.	15.400	229.837	.13012	3913.	1000.	5000.	18.466	3648.
29	4	.422	1.115	5064.	1357.	1.675	5243.	15.000	226.856	.12871	3905.	1000.	5000.	20.069	3996.
29		F =	3995.4	FID =		4068.3	ETAF = .9821		ISP =	199.093		ISPID =	200.688	ETAI = .9921	
26	5	.337	.875	5016.	1577.	1.694	5264.	17.662	223.692	.12721	3896.	1000.	5000.	14.071	2742.
27	5	.391	.948	5034.	1494.	1.677	5248.	16.430	226.083	.12834	3903.	1000.	5000.	15.508	3054.
28	5	.444	1.018	5058.	1418.	1.675	5255.	15.657	225.376	.12801	3901.	1000.	5000.	17.021	3382.
29	5	.496	1.088	5087.	1393.	1.687	5272.	15.214	222.640	.12671	3893.	1000.	5000.	18.549	3714.
30	5	.549	1.146	5119.	1372.	1.698	5300.	15.000	218.612	.12480	3881.	1000.	5000.	20.068	4044.
30		F =	4044.6	FID =		4128.0	ETAF = .9802		ISP =	201.529		ISPID =	203.534	ETAI = .9901	
26	6	.408	.857	5053.	1634.	1.701	5308.	17.925	217.505	.12427	3877.	1000.	5000.	12.959	2541.
27	6	.461	.927	5066.	1515.	1.693	5287.	16.625	220.407	.12565	3886.	1000.	5000.	14.294	2832.
28	6	.514	.991	5090.	1440.	1.696	5290.	15.801	220.068	.12549	3885.	1000.	5000.	15.719	3142.
29	6	.566	1.057	5118.	1402.	1.701	5307.	15.320	217.604	.12432	3878.	1000.	5000.	17.172	3458.
30	6	.616	1.119	5150.	1387.	1.712	5334.	15.076	213.786	.12250	3866.	1000.	5000.	18.628	3776.
31	6	.664	1.174	5184.	1389.	1.726	5367.	15.000	205.133	.12027	3852.	1000.	5000.	20.066	4091.
31		F =	4090.8	FID =		4176.8	ETAF = .9794		ISP =	203.838		ISPID =	206.040	ETAI = .9893	
26	7	.476	.830	5098.	1663.	1.721	5355.	18.089	210.803	.12107	3857.	1000.	5000.	11.965	2362.
27	7	.528	.890	5135.	1534.	1.711	5351.	16.727	214.205	.12270	3868.	1000.	5000.	13.205	2633.
28	7	.581	.967	5128.	1457.	1.711	5331.	15.857	214.238	.12271	3868.	1000.	5000.	14.545	2925.
29	7	.633	1.032	5156.	1414.	1.717	5346.	15.341	212.059	.12167	3861.	1000.	5000.	15.925	3225.
30	7	.683	1.094	5167.	1377.	1.728	5372.	15.070	208.467	.11995	3850.	1000.	5000.	17.317	3531.
31	7	.732	1.153	5221.	1376.	1.742	5404.	14.974	204.001	.11781	3836.	1000.	5000.	18.703	3835.
32	7	.780	1.209	5255.	1404.	1.757	5441.	15.000	199.031	.11541	3821.	1000.	5000.	20.068	4134.
32		F =	4134.7	FID =		4222.5	ETAF = .9793		ISP =	206.024		ISPID =	208.284	ETAI = .9892	
26	8	.540	.810	5134.	1606.	1.742	5405.	18.175	203.856	.11774	3836.	1000.	5000.	11.077	2201.
27	8	.591	.877	5149.	1550.	1.776	5377.	16.757	207.733	.11960	3848.	1000.	5000.	12.228	2453.
28	8	.644	.944	5170.	1467.	1.729	5374.	15.844	208.133	.11979	3849.	1000.	5000.	13.488	2729.
29	8	.696	1.009	5197.	1421.	1.735	5398.	15.296	206.242	.11888	3843.	1000.	5000.	14.797	3016.
30	8	.748	1.070	5228.	1401.	1.745	5412.	15.001	202.884	.11727	3833.	1000.	5000.	16.128	3308.
31	8	.797	1.129	5261.	1374.	1.758	5444.	14.886	198.615	.11521	3819.	1000.	5000.	17.460	3601.
32	8	.846	1.145	5295.	1407.	1.773	5479.	14.898	193.816	.11289	3804.	1000.	5000.	18.778	3891.

I	J	X	Y	U	V	W	VMAG	THETA	P	RHO	T	PT	TT	WDOT	F
33	8	.892	1.239	5330.	1429.	1.790	5518.	15.000	188.755	.11042	3787.	1000.	5000.	20.067	4176.
33		F =	4176.1	FID =		4263.5	ETAF = .9795		ISP =	208.089	ISPID =	210.315		ETAI = .9894	
26	9	.600	.792	5184.	1704.	1.764	5457.	19.198	196.863	.11436	3814.	1000.	5000.	10.284	2057.
27	9	.651	.859	5195.	1561.	1.750	5425.	16.728	201.186	.11645	3827.	1000.	5000.	11.352	2292.
28	9	.704	.923	5215.	1473.	1.748	5419.	15.777	201.941	.11682	3830.	1000.	5000.	12.576	2552.
29	9	.757	.987	5241.	1424.	1.753	5431.	15.200	200.333	.11604	3825.	1000.	5000.	13.773	2825.
30	9	.809	1.048	5271.	1401.	1.763	5454.	14.883	197.210	.11453	3815.	1000.	5000.	15.051	3105.
31	9	.859	1.107	5304.	1396.	1.776	5484.	14.751	193.143	.11256	3801.	1000.	5000.	16.331	3387.
32	9	.909	1.163	5337.	1405.	1.791	5519.	14.750	188.520	.11031	3786.	1000.	5000.	17.602	3664.
33	9	.956	1.217	5372.	1423.	1.807	5557.	14.842	183.615	.10791	3770.	1000.	5000.	18.851	3945.
34	9	1.001	1.268	5405.	1448.	1.824	5596.	15.000	178.617	.10546	3752.	1000.	5000.	20.067	4215.
34		F =	4215.1	FID =		4301.0	ETAF = .9800		ISP =	210.031	ISPID =	212.166		ETAI = .9899	
26	10	.658	.776	5234.	1718.	1.786	5508.	18.172	189.969	.11101	3791.	1000.	5000.	9.574	1927.
27	10	.708	.839	5243.	1569.	1.771	5473.	16.655	194.705	.11332	3807.	1000.	5000.	10.566	2146.
28	10	.761	.904	5262.	1476.	1.767	5465.	15.667	195.795	.11384	3810.	1000.	5000.	11.681	2392.
29	10	.814	.967	5286.	1423.	1.771	5474.	15.064	194.461	.11320	3806.	1000.	5000.	12.860	2652.
30	10	.867	1.028	5316.	1397.	1.781	5496.	14.728	191.570	.11179	3796.	1000.	5000.	14.076	2921.
31	10	.918	1.086	5348.	1391.	1.793	5526.	14.580	187.702	.10991	3783.	1000.	5000.	15.306	3192.
32	10	.969	1.142	5381.	1398.	1.808	5540.	14.568	183.256	.10774	3768.	1000.	5000.	16.533	3464.
33	10	1.017	1.196	5415.	1416.	1.824	5597.	14.651	178.509	.10541	3752.	1000.	5000.	17.742	3733.
34	10	1.063	1.248	5448.	1440.	1.841	5635.	14.802	173.654	.10301	3735.	1000.	5000.	18.923	3996.
35	10	1.109	1.297	5481.	1469.	1.858	5674.	15.000	168.823	.10062	3717.	1000.	5000.	20.067	4251.
35		F =	4251.7	FID =		4335.3	ETAF = .9807		ISP =	211.854	ISPID =	213.661		ETAI = .9956	
26	11	.712	.760	5284.	1728.	1.808	5560.	18.107	183.263	.10774	3768.	1000.	5000.	8.937	1811.
27	11	.762	.822	5292.	1572.	1.791	5520.	16.547	188.377	.11024	3786.	1000.	5000.	9.865	2015.
28	11	.815	.886	5309.	1475.	1.786	5510.	15.526	189.783	.11092	3790.	1000.	5000.	10.910	2247.
29	11	.868	.948	5332.	1419.	1.790	5518.	14.898	188.712	.11040	3787.	1000.	5000.	12.031	2495.
30	11	.922	1.008	5361.	1391.	1.799	5538.	14.544	186.045	.10910	3778.	1000.	5000.	13.194	2753.
31	11	.974	1.067	5392.	1383.	1.811	5567.	14.393	182.373	.10730	3765.	1000.	5000.	14.376	3015.
32	11	1.025	1.123	5425.	1389.	1.825	5600.	14.360	178.101	.10520	3750.	1000.	5000.	15.560	3278.
33	11	1.075	1.177	5458.	1405.	1.841	5636.	14.435	173.510	.10294	3734.	1000.	5000.	16.731	3539.
34	11	1.122	1.228	5491.	1428.	1.858	5674.	14.580	168.798	.10060	3717.	1000.	5000.	17.878	3795.
35	11	1.168	1.279	5524.	1457.	1.875	5713.	14.773	164.096	.09826	3700.	1000.	5000.	18.991	4044.
36	11	1.212	1.324	5555.	1489.	1.892	5751.	15.000	159.490	.09596	3682.	1000.	5000.	20.066	4285.
36		F =	4286.0	FID =		4367.0	ETAF = .9815		ISP =	213.562	ISPID =	215.421		ETAI = .9914	
26	12	.763	.746	5335.	1735.	1.829	5609.	18.014	176.885	.10461	3746.	1000.	5000.	8.372	1707.
27	12	.812	.807	5340.	1573.	1.811	5567.	16.414	182.341	.10729	3765.	1000.	5000.	9.231	1898.
28	12	.865	.869	5355.	1471.	1.805	5554.	15.363	184.038	.10812	3771.	1000.	5000.	10.222	2117.
29	12	.919	.930	5378.	1412.	1.808	5560.	14.713	183.213	.10771	3768.	1000.	5000.	11.289	2354.
30	12	.974	.990	5405.	1382.	1.816	5579.	14.342	180.758	.10651	3760.	1000.	5000.	12.403	2601.
31	12	1.027	1.048	5436.	1372.	1.828	5606.	14.170	177.273	.10480	3748.	1000.	5000.	13.546	2854.
32	12	1.079	1.105	5468.	1377.	1.842	5639.	14.138	173.167	.10277	3733.	1000.	5000.	14.684	3109.
33	12	1.129	1.159	5501.	1393.	1.858	5675.	14.206	168.728	.10057	3717.	1000.	5000.	15.819	3362.
34	12	1.178	1.210	5534.	1415.	1.875	5712.	14.346	164.153	.09829	3700.	1000.	5000.	16.933	3612.
35	12	1.225	1.260	5566.	1443.	1.892	5750.	14.535	159.578	.09600	3682.	1000.	5000.	18.017	3855.
36	12	1.270	1.307	5597.	1474.	1.909	5788.	14.758	155.098	.09375	3665.	1000.	5000.	19.066	4091.
37	12	1.312	1.351	5627.	1508.	1.925	5825.	15.000	150.793	.09158	3648.	1000.	5000.	20.066	4317.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
37		F =	4317.7	FID =		4395.8	ETAF = .9822		ISP =	215.142		ISPID =	216.846		ETAI = .9921
26	13	.912	.733	5385.	1739.	1.851	5659.	17.895	170.655	.10153	3724.	1000.	5000.	7.852	1610.
27	13	.861	.792	5389.	1571.	1.831	5613.	16.257	176.426	.10438	3745.	1000.	5000.	8.653	1789.
28	13	.914	.853	5402.	1465.	1.824	5598.	15.177	178.398	.10535	3751.	1000.	5000.	9.588	1997.
29	13	.969	.913	5424.	1403.	1.826	5602.	14.506	177.810	.10506	3749.	1000.	5000.	10.603	2223.
30	13	1.024	.973	5450.	1371.	1.834	5620.	14.121	175.561	.10395	3741.	1000.	5000.	11.676	2460.
31	13	1.078	1.031	5480.	1360.	1.846	5646.	13.937	172.259	.10232	3730.	1000.	5000.	12.765	2704.
32	13	1.131	1.087	5512.	1364.	1.860	5678.	13.897	168.319	.10037	3715.	1000.	5000.	13.870	2951.
33	13	1.182	1.141	5545.	1378.	1.875	5713.	13.959	164.029	.09823	3699.	1000.	5000.	14.969	3197.
34	13	1.232	1.193	5577.	1400.	1.892	5750.	14.094	159.591	.09601	3682.	1000.	5000.	16.051	3440.
35	13	1.280	1.242	5609.	1428.	1.908	5788.	14.279	155.142	.09377	3665.	1000.	5000.	17.107	3678.
36	13	1.326	1.290	5640.	1459.	1.925	5826.	14.500	150.767	.09157	3648.	1000.	5000.	18.130	3909.
37	13	1.370	1.334	5669.	1492.	1.942	5862.	14.740	146.578	.08944	3631.	1000.	5000.	19.107	4130.
38	13	1.412	1.378	5698.	1527.	1.959	5899.	15.000	142.464	.08734	3613.	1000.	5000.	20.066	4347.
38		F =	4348.0	FID =		4423.2	ETAF = .9830		ISP =	216.651		ISPID =	218.194		ETAI = .9929
26	14	.860	.721	5436.	1741.	1.873	5708.	17.756	164.639	.09854	3702.	1000.	5000.	7.376	1521.
27	14	.908	.778	5437.	1568.	1.851	5659.	16.082	170.699	.10155	3724.	1000.	5000.	8.122	1689.
28	14	.962	.837	5449.	1458.	1.843	5641.	14.975	172.930	.10265	3732.	1000.	5000.	9.005	1886.
29	14	1.017	.897	5469.	1393.	1.844	5644.	14.284	172.566	.10247	3731.	1000.	5000.	9.972	2101.
30	14	1.072	.957	5495.	1358.	1.852	5660.	13.884	170.516	.10146	3723.	1000.	5000.	10.994	2329.
31	14	1.127	1.014	5524.	1346.	1.863	5686.	13.690	167.391	.09991	3712.	1000.	5000.	12.048	2565.
32	14	1.181	1.070	5555.	1348.	1.877	5717.	13.643	163.611	.09802	3698.	1000.	5000.	13.115	2804.
33	14	1.234	1.124	5588.	1362.	1.892	5751.	13.699	159.467	.09595	3682.	1000.	5000.	14.181	3043.
34	14	1.285	1.176	5620.	1384.	1.908	5788.	13.830	155.163	.09379	3665.	1000.	5000.	15.232	3280.
35	14	1.334	1.226	5652.	1410.	1.925	5825.	14.013	150.837	.09160	3648.	1000.	5000.	16.250	3512.
36	14	1.381	1.273	5682.	1441.	1.942	5862.	14.231	146.576	.08944	3631.	1000.	5000.	17.257	3737.
37	14	1.425	1.318	5712.	1474.	1.959	5899.	14.469	142.491	.08736	3614.	1000.	5000.	18.211	3954.
38	14	1.469	1.362	5740.	1509.	1.976	5935.	14.728	138.475	.08530	3596.	1000.	5000.	19.150	4167.
39	14	1.511	1.405	5768.	1545.	1.992	5971.	15.000	134.581	.08330	3579.	1000.	5000.	20.066	4376.
39		F =	4376.7	FID =		4449.9	ETAF = .9838		ISP =	218.084		ISPID =	219.465		ETAI = .9937
26	15	.906	.709	5488.	1741.	1.895	57[illegible]7.	17.598	158.772	.09560	3679.	1000.	5000.	6.932	1432.
27	15	.954	.764	5486.	1562.	1.871	5704.	15.389	165.099	.09876	3703.	1000.	5000.	7.627	1594.
28	15	1.008	.823	5497.	1448.	1.862	5684.	14.756	167.575	.10000	3713.	1000.	5000.	8.460	1781.
29	15	1.063	.882	5515.	1380.	1.863	5685.	14.047	167.427	.09992	3712.	1000.	5000.	9.381	1987.
30	15	1.119	.940	5540.	1344.	1.869	5701.	13.634	165.569	.09900	3705.	1000.	5000.	10.360	2206.
31	15	1.175	.998	5568.	1330.	1.880	5725.	13.430	162.618	.09753	3694.	1000.	5000.	11.375	2433.
32	15	1.230	1.054	5599.	1331.	1.894	5755.	13.375	158.995	.09571	3680.	1000.	5000.	12.406	2665.
33	15	1.284	1.108	5631.	1344.	1.909	5789.	13.427	154.995	.09370	3665.	1000.	5000.	13.438	2897.
34	15	1.336	1.160	5663.	1365.	1.925	5825.	13.554	150.823	.09159	3648.	1000.	5000.	14.459	3128.
35	15	1.386	1.209	5694.	1392.	1.942	5862.	13.735	146.618	.08946	3631.	1000.	5000.	15.459	3354.
36	15	1.435	1.257	5725.	1422.	1.959	5899.	13.951	142.470	.08735	3613.	1000.	5000.	16.432	3575.
37	15	1.480	1.302	5754.	1455.	1.976	5935.	14.188	138.489	.08531	3596.	1000.	5000.	17.364	3786.
38	15	1.525	1.344	5782.	1490.	1.992	5971.	14.446	134.571	.08329	3579.	1000.	5000.	18.281	3995.
39	15	1.568	1.389	5810.	1526.	2.009	6007.	14.717	130.769	.08133	3562.	1000.	5000.	19.179	4200.
40	15	1.611	1.431	5837.	1564.	2.026	6042.	15.000	127.047	.07939	3545.	1000.	5000.	20.065	4404.
40		F =	4404.4	FID =		4473.7	ETAF = .9845		ISP =	219.463		ISPID =	220.684		ETAI = .9945
26	16	.953	.697	5540.	1738.	1.917	5807.	17.421	152.939	.09266	3656.	1000.	5000.	6.509	1358.
27	16	1.001	.750	5537.	1554.	1.892	5751.	15.677	159.517	.09597	3682.	1000.	5000.	7.155	1504.
28	16	1.054	.808	5545.	1436.	1.882	5728.	14.513	162.229	.09733	3693.	1000.	5000.	7.940	1680.
29	16	1.110	.866	5563.	1365.	1.881	5728.	13.790	162.293	.09736	3693.	1000.	5000.	8.815	1877.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
30	16	1.167	.924	5586.	1327.	1.888	5742.	13.364	160.625	.09653	3686.	1000.	5000.	9.753	2087.
31	16	1.224	.981	5614.	1312.	1.898	5765.	13.151	157.846	.09514	3676.	1000.	5000.	10.729	2306.
32	16	1.280	1.037	5644.	1312.	1.911	5794.	13.090	154.381	.09339	3662.	1000.	5000.	11.725	2530.
33	16	1.335	1.091	5675.	1325.	1.926	5828.	13.139	150.525	.09144	3647.	1000.	5000.	12.723	2756.
34	16	1.388	1.143	5707.	1345.	1.942	5863.	13.262	146.456	.08939	3630.	1000.	5000.	13.714	2990.
35	16	1.439	1.193	5738.	1371.	1.959	5899.	13.440	142.404	.08731	3613.	1000.	5000.	14.686	3200.
36	16	1.489	1.241	5768.	1401.	1.976	5936.	13.655	138.370	.08525	3596.	1000.	5000.	15.634	3410.
37	16	1.535	1.286	5797.	1434.	1.993	5972.	13.890	134.492	.08325	3579.	1000.	5000.	16.543	3623.
38	16	1.581	1.331	5826.	1468.	2.009	6008.	14.148	130.674	.08128	3562.	1000.	5000.	17.479	3828.
39	16	1.626	1.374	5853.	1505.	2.026	6043.	14.418	126.965	.07935	3545.	1000.	5000.	18.316	4025.
40	16	1.670	1.416	5880.	1543.	2.043	6079.	14.701	123.333	.07745	3528.	1000.	5000.	19.185	4224.
41	16	1.714	1.459	5906.	1583.	2.060	6115.	15.000	119.707	.07555	3510.	1000.	5000.	20.065	4431.
41		F =	4431.7	FID =		4497.9	ETAF = .9853		ISP = 220.820		ISPID =	221.882		ETAI = .9952	
26	17	1.002	.685	5597.	1734.	1.941	5859.	17.216	146.913	.08961	3632.	1000.	5000.	6.089	1279.
27	17	1.047	.736	5591.	1544.	1.914	5800.	15.437	153.737	.09307	3660.	1000.	5000.	6.684	1414.
28	17	1.102	.793	5597.	1422.	1.903	5775.	14.251	156.686	.09455	3671.	1000.	5000.	7.423	1580.
29	17	1.159	.850	5613.	1348.	1.901	5772.	13.504	156.965	.09469	3672.	1000.	5000.	8.253	1766.
30	17	1.216	.908	5635.	1303.	1.907	5785.	13.064	155.493	.09395	3667.	1000.	5000.	9.147	1965.
31	17	1.274	.964	5662.	1291.	1.917	5807.	12.842	152.892	.09264	3656.	1000.	5000.	10.082	2175.
32	17	1.331	1.020	5691.	1290.	1.930	5836.	12.775	149.590	.09097	3643.	1000.	5000.	11.040	2395.
33	17	1.387	1.074	5722.	1302.	1.945	5868.	12.819	145.885	.08909	3628.	1000.	5000.	12.006	2613.
34	17	1.442	1.126	5753.	1322.	1.961	5903.	12.939	141.984	.08710	3611.	1000.	5000.	12.965	2831.
35	17	1.495	1.176	5794.	1348.	1.977	5939.	13.115	138.030	.08507	3594.	1000.	5000.	13.909	3045.
36	17	1.545	1.224	5814.	1378.	1.994	5975.	13.323	134.115	.08306	3577.	1000.	5000.	14.830	3255.
37	17	1.593	1.269	5843.	1410.	2.011	6011.	13.564	130.347	.08111	3560.	1000.	5000.	15.715	3457.
38	17	1.640	1.314	5871.	1444.	2.028	6046.	13.821	126.632	.07918	3543.	1000.	5000.	16.580	3655.
39	17	1.685	1.357	5899.	1481.	2.044	6082.	14.091	123.022	.07729	3526.	1000.	5000.	17.446	3854.
40	17	1.732	1.400	5925.	1517.	2.061	6117.	14.374	119.483	.07543	3509.	1000.	5000.	18.296	4050.
41	17	1.777	1.443	5952.	1559.	2.079	6153.	14.673	115.951	.07357	3492.	1000.	5000.	19.157	4245.
42	17	1.825	1.499	5980.	1602.	2.097	6191.	15.000	112.299	.07163	3473.	1000.	5000.	20.065	4459.
42		F =	4459.6	FID =		4522.8	ETAF = .9860		ISP = 222.211		ISPID =	223.109		ETAI = .9950	
26	18	1.057	.672	5651.	1727.	1.968	5919.	16.966	140.286	.08623	3604.	1000.	5000.	5.645	1154.
27	18	1.103	.721	5652.	1530.	1.939	5855.	15.145	147.362	.08984	3634.	1000.	5000.	6.190	1317.
28	18	1.157	.776	5656.	1403.	1.926	5827.	13.930	150.563	.09146	3647.	1000.	5000.	6.876	1472.
29	18	1.214	.832	5670.	1326.	1.924	5823.	13.163	151.075	.09172	3649.	1000.	5000.	7.656	1649.
30	18	1.272	.889	5691.	1283.	1.929	5834.	12.709	149.816	.09108	3644.	1000.	5000.	8.503	1840.
31	18	1.331	.945	5717.	1265.	1.939	5855.	12.477	147.411	.08986	3634.	1000.	5000.	9.395	2041.
32	18	1.389	1.001	5745.	1264.	1.951	5883.	12.403	144.289	.08828	3621.	1000.	5000.	10.312	2243.
33	18	1.447	1.054	5775.	1274.	1.966	5914.	12.442	140.751	.08647	3606.	1000.	5000.	11.240	2460.
34	18	1.503	1.106	5806.	1294.	1.982	5949.	12.561	137.005	.08455	3590.	1000.	5000.	12.164	2670.
35	18	1.557	1.156	5837.	1319.	1.998	5984.	12.735	133.194	.08258	3573.	1000.	5000.	13.076	2878.
36	18	1.609	1.205	5867.	1349.	2.015	6020.	12.948	129.411	.08062	3556.	1000.	5000.	13.968	3082.
37	18	1.658	1.250	5895.	1381.	2.032	6055.	13.182	125.765	.07872	3539.	1000.	5000.	14.827	3279.
38	18	1.707	1.295	5923.	1415.	2.048	6090.	13.439	122.166	.07684	3522.	1000.	5000.	15.676	3473.
39	18	1.754	1.339	5951.	1452.	2.065	6125.	13.709	118.666	.07500	3505.	1000.	5000.	16.509	3665.
40	18	1.801	1.382	5977.	1489.	2.082	6160.	13.992	115.233	.07319	3488.	1000.	5000.	17.336	3856.
41	18	1.848	1.425	6004.	1529.	2.099	6196.	14.292	111.804	.07137	3470.	1000.	5000.	18.176	4051.
42	18	1.898	1.471	6032.	1573.	2.118	6233.	14.619	108.249	.06948	3452.	1000.	5000.	19.063	4256.
43	18	1.954	1.523	6062.	1624.	2.139	6276.	15.000	104.325	.06737	3431.	1000.	5000.	20.065	4489.
43		F =	4490.0	FID =		4550.0	ETAF = .9868		ISP = 223.729		ISPID =	224.452		ETAI = .9978	

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
26	19	1.124	.656	5741.	1715.	2.002	5992.	16.631	132.384	.08216	3570.	1000.	5000.	5.139	1096.
27	19	1.169	.702	5728.	1509.	1.970	5924.	14.763	139.738	.08595	3602.	1000.	5000.	5.624	1206.
28	19	1.223	.755	5729.	1377.	1.956	5892.	13.511	143.226	.08773	3617.	1000.	5000.	6.250	1348.
29	19	1.280	.810	5741.	1296.	1.953	5885.	12.718	144.010	.08813	3620.	1000.	5000.	6.972	1512.
30	19	1.340	.866	5760.	1250.	1.957	5894.	12.247	143.003	.08762	3616.	1000.	5000.	7.764	1692.
31	19	1.400	.922	5784.	1230.	1.966	5914.	12.004	140.832	.08651	3607.	1000.	5000.	8.604	1882.
32	19	1.460	.977	5812.	1227.	1.978	5940.	11.923	137.927	.08502	3594.	1000.	5000.	9.472	2080.
33	19	1.519	1.031	5841.	1237.	1.992	5971.	11.958	134.589	.08330	3579.	1000.	5000.	10.355	2281.
34	19	1.577	1.083	5872.	1256.	2.008	6004.	12.074	131.029	.08146	3563.	1000.	5000.	11.237	2482.
35	19	1.633	1.133	5902.	1281.	2.024	6039.	12.247	127.391	.07957	3547.	1000.	5000.	12.110	2682.
36	19	1.687	1.181	5931.	1310.	2.041	6074.	12.459	123.769	.07768	3530.	1000.	5000.	12.967	2878.
37	19	1.738	1.227	5960.	1342.	2.058	6109.	12.694	120.270	.07585	3513.	1000.	5000.	13.793	3068.
38	19	1.789	1.272	5988.	1377.	2.074	6144.	12.951	116.812	.07403	3496.	1000.	5000.	14.612	3257.
39	19	1.838	1.316	6015.	1413.	2.091	6179.	13.222	113.445	.07224	3479.	1000.	5000.	15.416	3443.
40	19	1.886	1.359	6041.	1451.	2.108	6213.	13.506	110.140	.07049	3462.	1000.	5000.	16.217	3628.
41	19	1.935	1.403	6068.	1491.	2.125	6248.	13.806	106.837	.06872	3444.	1000.	5000.	17.030	3817.
42	19	1.987	1.450	6096.	1535.	2.144	6286.	14.135	103.411	.06688	3426.	1000.	5000.	17.891	4017.
43	19	2.045	1.502	6126.	1586.	2.165	6328.	14.517	99.629	.06483	3404.	1000.	5000.	18.864	4244.
44	19	2.117	1.567	6163.	1651.	2.191	6380.	15.000	95.102	.06237	3378.	1000.	5000.	20.064	4525.

44 F = 4526.1 FID = 4582.4 ETAF = .9877 ISP = 225.527 ISPID = 226.049 ETAI = .9977

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
26	20	1.214	.634	5849.	1693.	2.048	6089.	16.139	122.242	.07688	3522.	1000.	5000.	4.523	975.
27	20	1.258	.677	5831.	1476.	2.013	6015.	14.207	129.909	.08088	3558.	1000.	5000.	4.934	1070.
28	20	1.311	.728	5828.	1335.	1.996	5979.	12.907	133.745	.08287	3576.	1000.	5000.	5.485	1196.
29	20	1.369	.781	5836.	1249.	1.991	5968.	12.081	134.868	.08345	3581.	1000.	5000.	6.135	1344.
30	20	1.430	.836	5853.	1200.	1.994	5975.	11.589	134.181	.08309	3578.	1000.	5000.	6.858	1508.
31	20	1.492	.891	5875.	1178.	2.002	5992.	11.333	132.309	.08212	3569.	1000.	5000.	7.631	1685.
32	20	1.554	.945	5902.	1173.	2.014	6017.	11.243	129.684	.08076	3557.	1000.	5000.	8.437	1869.
33	20	1.616	.999	5930.	1182.	2.028	6047.	11.273	126.607	.07916	3543.	1000.	5000.	9.260	2057.
34	20	1.676	1.051	5959.	1200.	2.043	6079.	11.387	123.290	.07743	3527.	1000.	5000.	10.088	2247.
35	20	1.734	1.101	5989.	1225.	2.059	6113.	11.559	119.878	.07564	3511.	1000.	5000.	10.911	2436.
36	20	1.791	1.149	6018.	1254.	2.076	6147.	11.772	116.466	.07384	3494.	1000.	5000.	11.721	2622.
37	20	1.845	1.195	6046.	1286.	2.093	6182.	12.008	113.161	.07209	3477.	1000.	5000.	12.504	2803.
38	20	1.898	1.241	6074.	1321.	2.109	6216.	12.266	109.888	.07035	3460.	1000.	5000.	13.282	2983.
39	20	1.950	1.285	6101.	1357.	2.126	6250.	12.539	106.695	.06864	3443.	1000.	5000.	14.049	3161.
40	20	2.001	1.329	6127.	1395.	2.143	62[illegible]4.	12.825	103.559	.06696	3426.	1000.	5000.	14.814	3339.
41	20	2.052	1.373	6154.	1435.	2.160	6319.	13.128	100.422	.06526	3409.	1000.	5000.	15.592	3521.
42	20	2.107	1.420	6182.	1479.	2.179	6356.	13.458	97.166	.06350	3390.	1000.	5000.	16.417	3713.
43	20	2.169	1.473	6212.	1531.	2.200	6398.	13.843	93.569	.06153	3369.	1000.	5000.	17.351	3932.
44	20	2.244	1.539	6249.	1596.	2.227	6449.	14.330	89.263	.05916	3343.	1000.	5000.	18.506	4204.
45	20	2.346	1.628	6296.	1687.	2.263	6518.	15.000	83.710	.05608	3307.	1000.	5000.	20.063	4571.

45 F = 4572.1 FID = 4624.1 ETAF = .9888 ISP = 227.820 ISPID = 228.105 ETAI = .9988

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
26	21	1.343	.605	6008.	1648.	2.116	6230.	15.339	108.541	.06963	3453.	1000.	5000.	3.748	821.
27	21	1.383	.642	5981.	1416.	2.076	6147.	13.315	116.546	.07389	3495.	1000.	5000.	4.067	895.
28	21	1.436	.689	5971.	1264.	2.055	6104.	11.947	120.805	.07613	3515.	1000.	5000.	4.523	1000.
29	21	1.495	.740	5975.	1170.	2.048	6088.	11.077	122.362	.07695	3523.	1000.	5000.	5.078	1127.
30	21	1.558	.793	5968.	1116.	2.049	6091.	10.557	122.099	.07681	3522.	1000.	5000.	5.707	1272.
31	21	1.623	.847	6007.	1090.	2.056	6105.	10.284	120.630	.07604	3515.	1000.	5000.	6.391	1425.
32	21	1.689	.900	6031.	1084.	2.067	6128.	10.186	118.386	.07486	3504.	1000.	5000.	7.113	1594.
33	21	1.754	.953	6058.	1091.	2.080	6156.	10.213	115.668	.07342	3490.	1000.	5000.	7.856	1766.
34	21	1.818	1.004	6086.	1109.	2.095	6186.	10.326	112.687	.07184	3475.	1000.	5000.	8.609	1939.
35	21	1.880	1.055	6115.	1133.	2.111	6219.	10.501	109.589	.07019	3459.	1000.	5000.	9.361	2113.
36	21	1.940	1.103	6143.	1163.	2.127	6252.	10.717	106.469	.06852	3442.	1000.	5000.	10.105	2286.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
37	21	1.998	1.145	6171.	1195.	2.144	6286.	10.956	103.435	.06689	3426.	1000.	5000.	10.828	2454.
38	21	2.055	1.195	6198.	1229.	2.161	6319.	11.219	100.418	.06526	3409.	1000.	5000.	11.550	2622.
39	21	2.111	1.240	6225.	1266.	2.177	6353.	11.497	97.470	.06366	3392.	1000.	5000.	12.263	2788.
40	21	2.166	1.284	6251.	1305.	2.194	6386.	11.787	94.569	.06208	3375.	1000.	5000.	12.976	2955.
41	21	2.221	1.329	6278.	1345.	2.212	6420.	12.095	91.663	.06048	3357.	1000.	5000.	13.704	3126.
42	21	2.280	1.377	6306.	1390.	2.231	6457.	12.430	88.545	.05882	3339.	1000.	5000.	14.478	3308.
43	21	2.347	1.431	6336.	1442.	2.252	6498.	12.821	85.308	.05697	3317.	1000.	5000.	15.357	3515.
44	21	2.429	1.498	6373.	1508.	2.279	6549.	13.314	81.311	.05474	3291.	1000.	5000.	16.446	3772.
45	21	2.540	1.589	6421.	1600.	2.315	6617.	13.993	76.156	.05183	3255.	1000.	5000.	17.920	4122.
46	21	2.700	1.723	6486.	1738.	2.368	6715.	15.000	69.143	.04782	3203.	1000.	5000.	20.061	4632.

46 F = 4633.6 FID = 4680.8 ETAF = .9899 ISP = 230.882 ISP10 = 230.901 ETAI = .9999

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
26	22	1.526	.563	6239.	1558.	2.217	6430.	14.018	90.839	.06003	3352.	1000.	5000.	2.836	635.
27	22	1.562	.593	6199.	1302.	2.168	6334.	11.862	99.111	.06455	3401.	1000.	5000.	3.048	684.
28	22	1.613	.634	6178.	1134.	2.142	6281.	10.399	103.826	.06710	3428.	1000.	5000.	3.387	763.
29	22	1.674	.681	6173.	1030.	2.130	6259.	9.469	105.899	.06822	3439.	1000.	5000.	3.825	865.
30	22	1.740	.731	6180.	959.	2.129	6256.	8.915	106.164	.06836	3441.	1000.	5000.	4.337	983.
31	22	1.809	.783	6195.	940.	2.134	6246.	8.626	105.214	.06785	3435.	1000.	5000.	4.906	1115.
32	22	1.879	.835	6216.	932.	2.144	6285.	8.524	103.469	.06691	3426.	1000.	5000.	5.516	1257.
33	22	1.949	.886	6240.	938.	2.156	6310.	8.553	101.226	.06570	3413.	1000.	5000.	6.153	1404.
34	22	2.019	.937	6266.	956.	2.170	6339.	8.674	98.693	.06433	3399.	1000.	5000.	6.806	1556.
35	22	2.087	.987	6293.	981.	2.186	6369.	8.857	96.016	.06287	3383.	1000.	5000.	7.463	1709.
36	22	2.154	1.035	6321.	1011.	2.202	6401.	9.084	93.291	.06138	3367.	1000.	5000.	8.118	1862.
37	22	2.217	1.082	6348.	1043.	2.218	6433.	9.335	90.620	.05991	3351.	1000.	5000.	8.759	2012.
38	22	2.280	1.128	6375.	1079.	2.235	6465.	9.609	87.953	.05844	3334.	1000.	5000.	9.402	2163.
39	22	2.342	1.173	6401.	1117.	2.252	6498.	9.897	85.335	.05698	3318.	1000.	5000.	10.041	2313.
40	22	2.403	1.218	6427.	1156.	2.269	6530.	10.199	82.752	.05554	3301.	1000.	5000.	10.682	2465.
41	22	2.465	1.263	6454.	1198.	2.287	6564.	10.517	80.160	.05409	3283.	1000.	5000.	11.349	[illegible]
42	22	2.531	1.312	6481.	1244.	2.306	6599.	10.864	77.464	.05257	3265.	1000.	5000.	12.041	[illegible]
43	22	2.605	1.367	6512.	1297.	2.327	6640.	11.266	74.479	.05088	3243.	1000.	5000.	12.841	2976.
44	22	2.697	1.436	6549.	1365.	2.355	6690.	11.774	70.901	.04883	3217.	1000.	5000.	13.837	3214.
45	22	2.821	1.530	6597.	1459.	2.392	6757.	12.471	66.283	.04617	3181.	1000.	5000.	15.191	3537.
46	22	3.002	1.668	6664.	1600.	2.446	6853.	13.501	60.003	.04249	3128.	1000.	5000.	17.170	4012.
47	22	3.267	1.875	6752.	1809.	2.525	6990.	15.000	51.830	.03761	3053.	1000.	5000.	20.056	4708.

47 F = 4711.5 FID = 4755.4 ETAF = .9908 ISP = 234.765 ISP10 = 234.582 ETAI =1.0009

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
26	23	1.686	.527	6431.	1465.	2.304	6596.	12.830	77.740	.05272	3266.	1000.	5000.	2.204	502.
27	23	1.715	.549	6379.	1188.	2.247	6488.	10.553	86.097	.05741	3323.	1000.	5000.	2.343	535.
28	23	1.764	.586	6348.	1006.	2.215	6427.	9.003	91.093	.06017	3354.	1000.	5000.	2.601	595.
29	23	1.825	.629	6336.	893.	2.201	6398.	8.022	93.522	.06150	3369.	1000.	5000.	2.953	678.
30	23	1.894	.677	6337.	828.	2.197	6391.	7.442	94.167	.06186	3373.	1000.	5000.	3.379	777.
31	23	1.966	.726	6348.	796.	2.200	6398.	7.144	93.601	.06155	3369.	1000.	5000.	3.862	889.
32	23	2.041	.777	6365.	786.	2.208	6414.	7.044	92.231	.06080	3361.	1000.	5000.	4.387	1012.
33	23	2.116	.828	6387.	793.	2.220	6436.	7.081	90.348	.05976	3349.	1000.	5000.	4.943	1141.
34	23	2.191	.878	6412.	811.	2.234	6463.	7.213	88.156	.05855	3336.	1000.	5000.	5.516	1275.
35	23	2.265	.927	6438.	837.	2.249	6492.	7.410	85.801	.05724	3321.	1000.	5000.	6.099	1412.
36	23	2.337	.975	6464.	868.	2.265	6522.	7.651	83.378	.05589	3305.	1000.	5000.	6.684	1550.
37	23	2.406	1.021	6491.	902.	2.281	6553.	7.915	80.988	.05455	3289.	1000.	5000.	7.260	1685.
38	23	2.474	1.067	6517.	939.	2.298	6585.	8.203	78.588	.05320	3272.	1000.	5000.	7.840	1822.
39	23	2.541	1.113	6543.	978.	2.315	6616.	8.504	76.226	.05187	3256.	1000.	5000.	8.418	1959.
40	23	2.608	1.158	6569.	1019.	2.332	6648.	8.818	73.888	.05054	3239.	1000.	5000.	9.002	2097.
41	23	2.675	1.204	6596.	1062.	2.350	6681.	9.149	71.537	.04920	3222.	1000.	5000.	9.602	2240.
42	23	2.747	1.253	6623.	1109.	2.369	6716.	9.509	69.088	.04779	3203.	1000.	5000.	10.245	2393.
43	23	2.829	1.310	6654.	1164.	2.391	6755.	9.925	66.375	.04622	3182.	1000.	5000.	10.980	2569.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
44	23	2.930	1.380	6692.	1234.	2.418	6805.	10.448	63.119	.04432	3155.	1000.	5000.	11.899	2789.
45	23	3.066	1.475	6741.	1330.	2.456	6871.	11.164	58.915	.04185	3119.	1000.	5000.	13.154	3090.
46	23	3.266	1.617	6808.	1474.	2.511	6966.	12.220	53.198	.03843	3066.	1000.	5000.	14.998	3536.
47	23	3.559	1.831	6898.	1688.	2.592	7102.	13.749	45.767	.03391	2990.	1000.	5000.	17.706	4192.
48	23	3.814	2.022	6966.	1867.	2.661	7212.	15.000	40.275	.03048	2927.	1000.	5000.	20.053	4763.
48		F =	4767.4	F1D =		4812.2	ETAF = .9907		ISP =	237.551	ISP1D =	237.386		ETAI =1.0007	
26	24	1.834	.492	6603.	1367.	2.384	6743.	11.694	67.184	.04669	3188.	1000.	5000.	1.723	398.
27	24	1.857	.509	6539.	1070.	2.320	6626.	9.296	75.528	.05147	3251.	1000.	5000.	1.808	418.
28	24	1.903	.540	6498.	874.	2.283	6557.	7.661	80.710	.05440	3287.	1000.	5000.	2.004	465.
29	24	1.965	.581	6478.	753.	2.265	6522.	6.631	83.408	.05591	3305.	1000.	5000.	2.289	532.
30	24	2.035	.625	6474.	684.	2.258	6510.	6.030	84.355	.05644	3311.	1000.	5000.	2.645	615.
31	24	2.111	.673	6491.	650.	2.260	6513.	5.729	84.100	.05630	3310.	1000.	5000.	3.057	712.
32	24	2.190	.722	6495.	641.	2.267	6527.	5.636	83.039	.05570	3303.	1000.	5000.	3.513	818.
33	24	2.270	.772	6515.	649.	2.278	6547.	5.687	81.453	.05482	3292.	1000.	5000.	3.999	932.
34	24	2.349	.821	6538.	668.	2.291	6572.	5.836	79.545	.05374	3279.	1000.	5000.	4.507	1052.
35	24	2.428	.870	6563.	696.	2.306	6600.	6.051	77.458	.05257	3264.	1000.	5000.	5.027	1174.
36	24	2.505	.917	6589.	728.	2.321	6629.	6.309	75.287	.05133	3249.	1000.	5000.	5.552	1298.
37	24	2.579	.964	6614.	764.	2.337	6658.	6.591	73.130	.05011	3233.	1000.	5000.	6.070	1420.
38	24	2.653	1.010	6641.	803.	2.354	6689.	6.895	70.953	.04886	3217.	1000.	5000.	6.596	1545.
39	24	2.725	1.055	6667.	844.	2.371	6720.	7.212	68.803	.04762	3201.	1000.	5000.	7.123	1670.
40	24	2.797	1.100	6693.	886.	2.388	6751.	7.541	66.669	.04639	3184.	1000.	5000.	7.656	1797.
41	24	2.871	1.147	6719.	931.	2.406	6783.	7.886	64.519	.04514	3167.	1000.	5000.	8.206	1928.
42	24	2.949	1.197	6747.	979.	2.426	6818.	8.260	62.277	.04383	3148.	1000.	5000.	8.797	2070.
43	24	3.037	1.253	6778.	1036.	2.448	6857.	8.691	59.789	.04236	3127.	1000.	5000.	9.475	2233.
44	24	3.147	1.324	6816.	1108.	2.476	6905.	9.233	56.801	.04[illegible]59	3100.	1000.	5000.	10.326	2438.
45	24	3.295	1.422	6865.	1207.	2.514	6971.	9.971	52.941	.03828	3064.	1000.	5000.	11.492	2719.
46	24	3.513	1.567	6934.	1355.	2.570	7065.	11.053	47.691	.03509	3011.	1000.	5000.	13.217	3137.
47	24	3.833	1.786	7026.	1572.	2.653	7199.	12.614	40.878	.03086	2935.	1000.	5000.	15.764	3758.
48	24	4.114	1.983	7096.	1754.	2.723	7309.	13.887	35.856	.02767	2871.	1000.	5000.	17.982	4299.
49	24	4.377	2.173	7153.	1917.	2.796	7405.	15.000	31.829	.02505	2815.	1000.	5000.	20.050	4804.
49		F =	4809.5	F1D =		4858.0	ETAF = .9900		ISP =	239.651	ISP1D =	239.642		ETAI =1.0000	
26	25	1.977	.459	6760.	1266.	2.460	6878.	10.606	58.470	.04158	3115.	1000.	5000.	1.345	315.
27	25	1.991	.469	6683.	949.	2.398	6750.	8.082	66.748	.04643	3185.	1000.	5000.	1.390	326.
28	25	2.035	.496	6632.	739.	2.346	6673.	6.359	72.058	.04949	3225.	1000.	5000.	1.5[illegible]7	361.
29	25	2.096	.533	6605.	611.	2.324	6633.	5.282	74.970	.05115	3247.	1000.	5000.	1.768	415.
30	25	2.168	.576	6595.	538.	2.315	6617.	4.664	76.167	.05183	3255.	1000.	5000.	2.065	485.
31	25	2.247	.621	6598.	504.	2.315	6617.	4.366	76.174	.05184	3255.	1000.	5000.	2.418	568.
32	25	2.329	.669	6609.	495.	2.321	6628.	4.286	75.373	.05138	3250.	1000.	5000.	2.814	661.
33	25	2.414	.717	6627.	505.	2.331	6646.	4.357	74.040	.05063	3240.	1000.	5000.	3.242	762.
34	25	2.498	.766	6648.	526.	2.343	6669.	4.527	72.374	.04967	3228.	1000.	5000.	3.692	868.
35	25	2.582	.814	6672.	556.	2.358	6695.	4.765	70.514	.04861	3214.	1000.	5000.	4.156	977.
36	25	2.664	.861	6697.	591.	2.373	6723.	5.045	68.557	.04748	3199.	1000.	5000.	4.628	1089.
37	25	2.744	.907	6723.	629.	2.389	6752.	5.346	66.598	.04635	3183.	1000.	5000.	5.098	1200.
38	25	2.823	.953	6749.	670.	2.405	6782.	5.670	64.610	.04519	3167.	1000.	5000.	5.575	1314.
39	25	2.900	.998	6775.	713.	2.422	6812.	6.005	62.638	.04404	3151.	1000.	5000.	6.055	1429.
40	25	2.978	1.043	6801.	757.	2.440	6843.	6.351	60.677	.04289	3134.	1000.	5000.	6.544	1545.
41	25	3.057	1.090	6827.	804.	2.458	6874.	6.713	58.698	.04172	3117.	1000.	5000.	7.049	1666.
42	25	3.140	1.140	6855.	854.	2.477	6908.	7.103	56.629	.04049	3098.	1000.	5000.	7.594	1797.
43	25	3.235	1.197	6886.	913.	2.500	6947.	7.552	54.331	.03912	3077.	1000.	5000.	8.221	1948.
44	25	3.354	1.269	6925.	987.	2.520	6995.	8.113	51.569	.03745	3050.	1000.	5000.	9.011	2139.
45	25	3.514	1.368	6975.	1089.	2.567	7059.	8.874	48.000	.03528	3014.	1000.	5000.	10.098	2402.
46	25	3.750	1.516	7045.	1240.	2.624	7153.	9.986	43.144	.03228	2961.	1000.	5000.	11.713	2796.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
47	25	4.098	1.740	7138.	1463.	2.708	7287.	11.581	36.850	.02830	2884.	1000.	5000.	14.114	3382.
48	25	4.402	1.943	7210.	1648.	2.780	7396.	12.876	32.224	.02531	2821.	1000.	5000.	16.215	3897.
49	25	4.689	2.138	7269.	1813.	2.844	7491.	14.005	28.526	.02297	2764.	1000.	5000.	18.180	4378.
50	25	4.964	2.330	7318.	1961.	2.904	7576.	15.000	25.502	.02083	2713.	1000.	5000.	20.049	4835.
50		F =	4890.4	FID =		4894.2	ETAF = .9890		ISP = 241.187		ISPID = 241.429			ETAI = .9990	
26	26	2.116	.825	6906.	1162.	2.553	7003.	9.532	51.114	.03718	3046.	1000.	5000.	1.041	247.
27	26	2.122	.429	6815.	824.	2.452	6865.	5.892	59.296	.04207	3122.	1000.	5000.	1.056	250.
28	26	2.161	.452	6754.	600.	2.405	6780.	5.074	64.703	.04525	3168.	1000.	5000.	1.164	276.
29	26	2.222	.485	6719.	464.	2.379	6734.	3.949	67.795	.04704	3193.	1000.	5000.	1.349	320.
30	26	2.295	.526	6705.	389.	2.368	6714.	3.320	69.208	.04786	3204.	1000.	5000.	1.598	379.
31	26	2.377	.570	6701.	355.	2.366	6711.	3.030	69.443	.04799	3206.	1000.	5000.	1.899	450.
32	26	2.464	.616	6710.	348.	2.370	6719.	2.972	68.871	.04766	3201.	1000.	5000.	2.243	531.
33	26	2.552	.663	6725.	361.	2.379	6735.	3.069	67.760	.04702	3193.	1000.	5000.	2.619	619.
34	26	2.642	.710	6745.	385.	2.391	6756.	3.268	66.303	.04618	3181.	1000.	5000.	3.018	713.
35	26	2.731	.757	6768.	418.	2.405	6781.	3.533	64.640	.04521	3169.	1000.	5000.	3.433	812.
36	26	2.818	.8[illegible]	6793.	456.	2.420	6808.	3.840	62.868	.04417	3153.	1000.	5000.	3.858	913.
37	26	2.902	.850	6818.	497.	2.436	6836.	4.166	61.080	.04312	3138.	1000.	5000.	4.232	1013.
38	26	2.986	.895	6844.	540.	2.453	6865.	4.513	59.254	.04205	3122.	1000.	5000.	4.717	1117.
39	26	3.069	.941	6870.	585.	2.470	6895.	4.869	57.436	.04097	3106.	1000.	5000.	5.155	1222.
40	26	3.152	.986	6896.	632.	2.487	6925.	5.235	55.623	.03999	3089.	1000.	5000.	5.603	1329.
41	26	3.236	1.033	6923.	681.	2.505	6956.	5.616	53.789	.03879	3072.	1000.	5000.	6.067	1441.
42	26	3.326	1.085	6951.	734.	2.525	6989.	6.024	51.868	.03763	3053.	1000.	5000.	6.570	1562.
43	26	3.428	1.141	6982.	795.	2.548	7027.	6.492	49.733	.03634	3032.	1000.	5000.	7.151	1702.
44	26	3.555	1.213	7021.	871.	2.576	7075.	7.074	47.164	.03477	3005.	1000.	5000.	7.885	1880.
45	26	3.727	1.314	7072.	976.	2.615	7139.	7.862	43.842	.03271	2969.	1000.	5000.	8.899	2126.
46	26	3.981	1.454	7143.	1132.	2.674	7232.	9.005	39.322	.02988	2916.	1000.	5000.	10.414	2496.
47	26	4.356	1.695	7239.	1359.	2.740	7365.	10.635	33.471	.02612	2838.	1000.	5000.	12.680	3052.
48	26	4.685	1.901	7312.	1549.	2.832	7474.	11.952	29.184	.02330	2774.	1000.	5000.	14.673	3541.
49	26	4.994	2.101	7372.	1715.	2.898	7569.	13.097	25.766	.02101	2717.	1000.	5000.	16.543	4000.
50	26	5.292	2.299	7423.	1865.	2.959	7653.	14.104	22.980	.01910	2666.	1000.	5000.	18.325	4435.
51	26	5.582	2.495	7466.	2001.	3.015	7730.	15.000	20.663	.01748	2619.	1000.	5000.	20.047	4855.
51		F =	4861.2	FID =		4921.6	ETAF = .9877		ISP = 242.225		ISPID = 242.782			ETAI = .9977	
26	27	2.254	.391	7041.	1056.	2.604	7120.	8.525	44.823	.03332	2980.	1000.	5000.	.795	190.
27	27													.857	205.
28	27	2.284	.438	6866.	452.	2.461	6880.	3.763	58.314	.04149	3114.	1000.	5000.	1.004	240.
29	27	2.343	.439	6822.	309.	2.432	6829.	2.592	61.564	.04341	3142.	1000.	5000.	1.211	289.
30	27	2.418	.476	6800.	232.	2.418	6804.	1.957	63.173	.04435	3155.	1000.	5000.	1.467	350.
31	27	2.503	.518	6794.	200.	2.414	6797.	1.687	63.618	.04461	3159.	1000.	5000.	1.765	420.
32	27	2.593	.562	6800.	197.	2.417	6802.	1.661	63.255	.04440	3156.	1000.	5000.	2.094	497.
33	27	2.687	.608	6813.	213.	2.425	6817.	1.794	62.345	.04387	3149.	1000.	5000.	2.448	581.
34	27	2.781	.654	6832.	242.	2.436	6836.	2.031	61.078	.04312	3138.	1000.	5000.	2.818	669.
35	27	2.875	.701	6854.	279.	2.450	6860.	2.332	59.592	.04225	3125.	1000.	5000.	3.200	760.
36	27	2.967	.747	6878.	321.	2.464	6886.	2.672	57.984	.04130	3111.	1000.	5000.	3.584	851.
37	27	3.057	.792	6903.	365.	2.480	6913.	3.028	56.345	.04032	3096.	1000.	5000.	3.978	946.
38	27	3.146	.838	6929.	412.	2.496	6941.	3.402	54.662	.03931	3080.	1000.	5000.	4.378	1041.
39	27	3.234	.883	6955.	460.	2.513	6970.	3.784	52.979	.03830	3064.	1000.	5000.	4.788	1140.
40	27	3.322	.928	6981.	509.	2.531	6999.	4.173	51.294	.03729	3048.	1000.	5000.	5.215	1243.
41	27	3.412	.975	7008.	561.	2.549	7030.	4.575	49.586	.03625	3031.	1000.	5000.	5.679	1355.
42	27	3.509	1.026	7036.	616.	2.569	7063.	5.005	47.794	.03515	3012.	1000.	5000.	6.217	1485.
43	27	3.617	1.084	7068.	680.	2.592	7101.	5.495	45.799	.03393	2991.	1000.	5000.	6.896	1651.
44	27	3.752	1.157	7108.	760.	2.621	7148.	6.101	43.397	.03244	2964.	1000.	5000.	7.845	1781.
45	27	3.957	1.258	7159.	865.	2.661	7212.	6.916	40.288	.03049	2928.	1000.	5000.		

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
46	27	4.208	1.410	7232.	1028.	2.720	7305.	8.093	36.059	.02780	2874.	1000.	5000.	9.267	2229.
47	27	4.610	1.644	7329.	1261.	2.807	7437.	9.761	30.591	.02424	2796.	1000.	5000.	11.407	2755.
48	27	4.964	1.857	7404.	1453.	2.882	7545.	11.101	26.596	.02157	2732.	1000.	5000.	13.299	3220.
49	27	5.297	2.063	7465.	1622.	2.949	7639.	12.262	23.421	.01940	2674.	1000.	5000.	15.080	3657.
50	27	5.616	2.265	7517.	1774.	3.010	7724.	13.280	20.840	.01760	2623.	1000.	5000.	16.781	4074.
51	27	5.928	2.467	7562.	1911.	3.068	7799.	14.184	18.701	.01608	2576.	1000.	5000.	18.428	4475.
52	27	6.235	2.670	7601.	2037.	3.121	7869.	15.000	16.893	.01478	2533.	1000.	5000.	20.037	4864.

52 F = 4872.6 FID = 4940.4 ETAF = .9863 ISP = 242.794 ISPID = 243.707 ETAI = .9963

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
26	28	2.393	.356	7169.	946.	2.673	7231.	7.521	39.391	.02992	2917.	1000.	5000.	.594	144.
27	28														
28	28	2.405	.362	6966.	299.	2.515	6972.	2.455	52.859	.03823	3063.	1000.	5000.	.614	149.
29	28	2.463	.390	6912.	149.	2.481	6914.	1.236	56.264	.04027	3095.	1000.	5000.	.729	176.
30	28	2.539	.425	6884.	72.	2.464	6885.	.603	58.062	.04134	3111.	1000.	5000.	.899	216.
31	28	2.626	.465	6874.	44.	2.458	6874.	.365	58.705	.04172	3117.	1000.	5000.	1.116	268.
32	28	2.721	.508	6877.	46.	2.459	6877.	.384	58.535	.04162	3116.	1000.	5000.	1.372	328.
33	28	2.819	.552	6888.	68.	2.456	6889.	.567	57.807	.04119	3109.	1000.	5000.	1.660	396.
34	28	2.918	.597	6906.	103.	2.477	6907.	.852	56.708	.04054	3099.	1000.	5000.	1.972	470.
35	28	3.017	.643	6927.	145.	2.489	6929.	1.198	55.375	.03974	3087.	1000.	5000.	2.302	548.
36	28	3.115	.689	6951.	192.	2.504	6954.	1.578	53.907	.03886	3073.	1000.	5000.	2.644	630.
37	28	3.209	.733	6976.	240.	2.519	6980.	1.970	52.396	.03795	3059.	1000.	5000.	2.990	712.
38	28	3.304	.778	7002.	291.	2.536	7008.	2.377	50.832	.03701	3043.	1000.	5000.	3.348	798.
39	28	3.397	.823	7028.	342.	2.553	7036.	2.787	49.261	.03605	3027.	1000.	5000.	3.713	885.
40	28	3.491	.869	7054.	395.	2.570	7065.	3.203	47.682	.03508	3011.	1000.	5000.	4.089	976.
41	28	3.586	.916	7081.	449.	2.589	7096.	3.629	46.078	.03410	2994.	1000.	5000.	4.482	1071.
42	28	3.688	.967	7110.	507.	2.609	7128.	4.082	44.393	.03306	2975.	1000.	5000.	4.909	1174.
43	28	3.803	1.025	7143.	574.	2.632	7166.	4.595	42.514	.03189	2954.	1000.	5000.	5.407	1295.
44	28	3.947	1.099	7183.	657.	2.661	7213.	5.227	40.249	.03046	2927.	1000.	5000.	6.041	1449.
45	28	4.143	1.201	7235.	770.	2.702	7276.	6.072	37.317	.02860	2890.	1000.	5000.	6.925	1665.
46	28	4.433	1.356	7309.	934.	2.762	7369.	7.284	33.330	.02603	2836.	1000.	5000.	8.261	1992.
47	28	4.862	1.594	7408.	1172.	2.851	7501.	8.988	28.181	.02264	2758.	1000.	5000.	10.286	2490.
48	28	5.239	1.811	7485.	1367.	2.926	7608.	10.350	24.433	.02010	2693.	1000.	5000.	12.085	2933.
49	28	5.594	2.022	7547.	1539.	2.995	7703.	11.525	21.462	.01804	2636.	1000.	5000.	13.785	3351.
50	28	5.936	2.230	7600.	1692.	3.058	7786.	12.553	19.055	.01634	2584.	1000.	5000.	15.412	3749.
51	28	6.269	2.437	7646.	1831.	3.116	7862.	13.465	17.065	.01490	2537.	1000.	5000.	16.990	4133.
52	28	6.597	2.646	7686.	1957.	3.170	7931.	14.285	15.389	.01367	2494.	1000.	5000.	18.534	4506.
53	28	6.918	2.853	7720.	2069.	3.220	7992.	15.000	13.997	.01263	2455.	1000.	5000.	20.035	4866.

53 F = 4874.9 FID = 4950.2 ETAF = .9848 ISP = 242.905 ISPID = 244.191 ETAI = .9947

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
26	29	2.532	.319	7289.	835.	2.741	7337.	6.536	34.669	.02690	2855.	1000.	5000.	.430	105.
27	29														
28	29														
29	29	2.578	.341	6997.	-32.	2.529	6997.	-.261	51.448	.03738	3049.	1000.	5000.	.495	121.
30	29	2.655	.374	6961.	-106.	2.509	6962.	-.871	53.446	.03858	3069.	1000.	5000.	.634	154.
31	29	2.746	.411	6946.	-127.	2.500	6947.	-1.051	54.299	.03910	3077.	1000.	5000.	.815	197.
32	29	2.844	.452	6946.	-117.	2.500	6947.	-.962	54.331	.03912	3077.	1000.	5000.	1.034	248.
33	29	2.947	.495	6955.	-86.	2.505	6956.	-.708	53.788	.03879	3072.	1000.	5000.	1.283	307.
34	29	3.052	.540	6972.	-43.	2.515	6972.	-.356	52.855	.03823	3063.	1000.	5000.	1.557	372.
35	29	3.156	.584	6993.	6.	2.527	6993.	.050	51.673	.03751	3051.	1000.	5000.	1.849	441.
36	29	3.259	.629	7016.	59.	2.541	7017.	.484	50.335	.03670	3038.	1000.	5000.	2.154	514.
37	29	3.360	.674	7041.	113.	2.556	7042.	.921	48.941	.03585	3024.	1000.	5000.	2.466	588.
38	29	3.460	.718	7067.	169.	2.573	7069.	1.368	47.486	.03496	3009.	1000.	5000.	2.789	666.
39	29	3.558	.763	7093.	225.	2.589	7097.	1.815	46.015	.03406	2993.	1000.	5000.	3.121	745.
40	29	3.657	.808	7120.	281.	2.607	7126.	2.262	44.531	.03314	2977.	1000.	5000.	3.464	828.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
41	29	3.758	.855	7148.	339.	2.626	7156.	2.717	43.019	.03220	2960.	1000.	5000.	3.824	915.
42	29	3.866	.906	7177.	401.	2.646	7188.	3.198	41.427	.03120	2941.	1000.	5000.	4.218	1010.
43	29	3.988	.965	7210.	471.	2.669	7225.	3.738	39.649	.03008	2920.	1000.	5000.	4.679	1122.
44	29	4.141	1.039	7251.	558.	2.699	7272.	4.400	37.505	.02872	2893.	1000.	5000.	5.267	1266.
45	29	4.349	1.142	7304.	675.	2.740	7335.	5.278	34.727	.02694	2856.	1000.	5000.	6.092	1467.
46	29	4.656	1.299	7379.	844.	2.801	7428.	6.527	30.950	.02447	2802.	1000.	5000.	7.346	1775.
47	29	5.112	1.542	7481.	1087.	2.892	7560.	8.270	26.082	.02122	2723.	1000.	5000.	9.260	2247.
48	29	5.513	1.763	7558.	1286.	2.969	7667.	9.654	22.549	.01880	2658.	1000.	5000.	10.971	2668.
49	29	5.892	1.979	7623.	1460.	3.039	7761.	10.844	19.759	.01684	2600.	1000.	5000.	12.594	3067.
50	29	6.255	2.192	7677.	1615.	3.102	7845.	11.882	17.505	.01522	2548.	1000.	5000.	14.151	3448.
51	29	6.609	2.405	7723.	1755.	3.162	7920.	12.800	15.647	.01386	2501.	1000.	5000.	15.664	3816.
52	29	6.958	2.619	7764.	1882.	3.217	7988.	13.625	14.086	.01270	2457.	1000.	5000.	17.147	4174.
53	29	7.299	2.831	7799.	1994.	3.268	8050.	14.343	12.793	.01172	2418.	1000.	5000.	18.589	4519.
54	29	7.639	3.047	7830.	2098.	3.316	8106.	15.000	11.678	.01086	2382.	1000.	5000.	20.016	4854.
54		F =	4868.1	FID =		4951.0	ETAF = .9833		ISP =	242.566	ISPID =		244.229	ETAI = .9932	
26	30	2.674	.281	7403.	722.	2.808	7438.	5.567	30.541	.02420	2795.	1000.	5000.	.298	74.
27	30														
28	30														
29	30	2.693	.289	7064.	-219.	2.572	7068.	-1.774	47.559	.03501	3010.	1000.	5000.	.319	79.
30	30	2.772	.319	7021.	-287.	2.547	7027.	-2.337	49.786	.03637	3033.	1000.	5000.	.430	105.
31	30	2.866	.355	7001.	-297.	2.535	7007.	-2.428	50.862	.03702	3043.	1000.	5000.	.579	140.
32	30	2.969	.394	6998.	-273.	2.533	7003.	-2.237	51.096	.03716	3046.	1000.	5000.	.764	184.
33	30	3.076	.436	7006.	-231.	2.537	7010.	-1.885	50.724	.03694	3042.	1000.	5000.	.978	234.
34	30	3.186	.479	7022.	-177.	2.545	7024.	-1.445	49.934	.03646	3034.	1000.	5000.	1.217	291.
35	30	3.296	.523	7042.	-118.	2.557	7043.	-.962	48.868	.03581	3023.	1000.	5000.	1.474	352.
36	30	3.404	.568	7066.	-57.	2.571	7066.	-.464	47.633	.03505	3010.	1000.	5000.	1.746	417.
37	30	3.510	.612	7091.	3.	2.586	7091.	.028	46.325	.03425	2996.	1000.	5000.	2.025	483.
38	30	3.615	.656	7117.	65.	2.602	7117.	.522	44.947	.03340	2981.	1000.	5000.	2.318	553.
39	30	3.719	.701	7144.	126.	2.619	7145.	1.008	43.545	.03253	2966.	1000.	5000.	2.619	626.
40	30	3.823	.746	7171.	187.	2.637	7174.	1.490	42.126	.03164	2949.	1000.	5000.	2.932	701.
41	30	3.929	.794	7199.	248.	2.656	7204.	1.976	40.677	.03073	2932.	1000.	5000.	3.263	781.
42	30	4.042	.845	7229.	314.	2.676	7236.	2.485	39.149	.02977	2914.	1000.	5000.	3.627	869.
43	30	4.171	.904	7263.	387.	2.700	7273.	3.053	37.441	.02868	2892.	1000.	5000.	4.053	973.
44	30	4.332	.979	7305.	478.	2.730	7320.	3.743	35.380	.02736	2865.	1000.	5000.	4.601	1107.
45	30	4.551	1.083	7359.	599.	2.772	7384.	4.652	32.711	.02563	2828.	1000.	5000.	5.373	1296.
46	30	4.875	1.243	7436.	773.	2.834	7476.	5.935	29.087	.02324	2773.	1000.	5000.	6.554	1586.
47	30	5.356	1.489	7540.	1021.	2.927	7608.	7.711	24.429	.02009	2693.	1000.	5000.	8.371	2034.
48	30	5.779	1.716	7619.	1222.	3.005	7716.	9.112	21.062	.01776	2628.	1000.	5000.	10.004	2437.
49	30	6.178	1.936	7684.	1398.	3.076	7810.	10.311	18.412	.01588	2569.	1000.	5000.	11.560	2819.
50	30	6.562	2.154	7739.	1554.	3.141	7894.	11.355	16.279	.01433	2517.	1000.	5000.	13.057	3185.
51	30	6.935	2.372	7786.	1694.	3.201	7969.	12.277	14.525	.01303	2470.	1000.	5000.	14.515	3539.
52	30	7.304	2.591	7828.	1822.	3.257	8037.	13.104	13.055	.01192	2426.	1000.	5000.	15.945	3883.
53	30	7.663	2.808	7863.	1935.	3.308	8098.	13.822	11.842	.01099	2387.	1000.	5000.	17.337	4214.
54	30	8.021	3.029	7895.	2039.	3.357	8154.	14.479	10.797	.01018	2351.	1000.	5000.	18.715	4538.
54	30	7.870	3.036	7869.	2062.	3.341	8135.	14.684	11.141	.01044	2363.	1000.	5000.	12.110	2929.
55	30	8.071	3.162	7886.	2113.	3.366	8164.	15.000	10.619	.01004	2344.	1000.	5000.	12.110	2929.
55		F =	4860.0	FID =		4947.2	ETAF = .9824		ISP =	242.166	ISPID =		244.042	ETAI = .9923	

ROTATIONAL FLOWFIELD ALONG LEFT-RUNNING CHARACTERISTICS THAT PASS THROUGH THE OBLIQUE SHOCK WAVE.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
55	31	4.471	3.162	7886.	2115.	3.366	8164.	15.000	10.619	.01004	2344.	1000.	5000.	12.110	2929.
55	31	4.371	3.162	7378.	0.	2.768	7378.	.004	28.970	.02267	2831.	879.	5000.	12.110	2929.
26	31	2.319	.241	7511.	606.	2.875	7536.	4.612	26.920	.02179	2737.	1000.	5000.	.194	49.
27	31														
28	31														
29	31														
30	31	2.481	.266	7076.	-516.	2.558	7095.	-4.169	46.117	.03412	2994.	1000.	5000.	.253	63.
31	31	2.979	.299	7050.	-504.	2.572	7068.	-4.092	47.518	.03498	3009.	1000.	5000.	.374	91.
32	31	3.087	.336	7044.	-459.	2.566	7059.	-3.727	48.028	.03530	3015.	1000.	5000.	.527	127.
33	31	3.201	.376	7050.	-396.	2.568	7062.	-3.218	47.880	.03521	3013.	1000.	5000.	.708	170.
34	31	3.317	.418	7066.	-326.	2.575	7073.	-2.644	47.266	.03483	3006.	1000.	5000.	.913	218.
35	31	3.432	.461	7086.	-254.	2.586	7091.	-2.051	46.337	.03426	2997.	1000.	5000.	1.138	272.
36	31	3.547	.505	7110.	-181.	2.599	7112.	-1.461	45.211	.03356	2984.	1000.	5000.	1.378	329.
37	31	3.658	.549	7135.	-112.	2.614	7136.	-.896	43.989	.03280	2971.	1000.	5000.	1.626	388.
38	31	3.764	.593	7162.	-42.	2.630	7162.	-.340	42.685	.03199	2956.	1000.	5000.	1.888	451.
39	31	3.876	.638	7190.	25.	2.647	7190.	.198	41.348	.03115	2940.	1000.	5000.	2.160	516.
40	31	3.987	.683	7218.	91.	2.665	7218.	.724	39.988	.03030	2924.	1000.	5000.	2.445	585.
41	31	4.099	.730	7246.	158.	2.684	7248.	1.248	38.594	.02942	2907.	1000.	5000.	2.747	658.
42	31	4.218	.782	7277.	228.	2.704	7281.	1.792	37.122	.02848	2888.	1000.	5000.	3.080	739.
43	31	4.351	.841	7312.	305.	2.729	7318.	2.393	35.475	.02742	2866.	1000.	5000.	3.474	835.
44	31	4.522	.917	7354.	400.	2.759	7365.	3.116	33.486	.02613	2839.	1000.	5000.	3.982	959.
45	31	4.751	1.027	7410.	526.	2.802	7429.	4.060	30.912	.02445	2801.	1000.	5000.	4.702	1135.
46	31	5.092	1.186	7488.	705.	2.865	7522.	5.380	27.422	.02213	2746.	1000.	5000.	5.813	1408.
47	31	5.400	1.436	7594.	956.	2.959	7654.	7.190	22.950	.01908	2665.	1000.	5000.	7.535	1833.
48	31	6.149	1.666	7675.	1162.	3.059	7762.	8.607	19.733	.01682	2599.	1000.	5000.	9.093	2218.
49	31	6.466	1.892	7741.	1339.	3.111	7856.	9.816	17.209	.01501	2541.	1000.	5000.	10.584	2584.
50	31	6.169	2.115	7797.	1497.	3.177	7940.	10.865	15.184	.01352	2488.	1000.	5000.	12.023	2936.
51	31	7.363	2.337	7845.	1637.	3.278	8014.	11.789	13.525	.01228	2441.	1000.	5000.	13.427	3276.
52	31	7.652	2.561	7887.	1766.	3.295	8082.	12.619	12.139	.01122	2397.	1000.	5000.	14.808	3607.
53	31	4.328	2.783	7923.	1878.	3.348	8143.	13.336	10.996	.01033	2358.	1000.	5000.	16.151	3925.
54	31	4.434	3.009	7956.	1982.	3.397	8199.	13.993	10.015	.00956	2321.	1000.	5000.	17.483	4236.
55	31	4.464	3.060	7962.	2002.	3.407	8210.	14.116	9.825	.00941	2314.	1000.	5000.	19.935	4585.
55	31	4.464	3.062	7434.	-100.	2.806	7435.	-.772	26.907	.02131	2797.	878.	5000.	18.935	4585.
56	31	4.764	3.162	7474.	0.	2.853	7474.	0.000	25.646	.02048	2774.	879.	5000.	19.724	4777.
56		F =	4460.3	FID =		4947.2	ETAF = .9874		ISP =	242.166	ISPID =		244.042	ETAI = .9923	
26	32	2.768	.190	7614.	448.	2.942	7630.	3.670	23.734	.01962	2680.	1000.	5000.	.114	29.
27	32														
28	32														
29	32														
30	32														
31	32	3.084	.242	7069.	-763.	2.610	7110.	-6.141	44.323	.03301	2974.	1000.	5000.	.208	52.
32	32	3.321	.277	7076.	-678.	2.598	7111.	-5.475	45.286	.03361	2985.	1000.	5000.	.332	81.
33	32	3.322	.315	7084.	-563.	2.596	7108.	-4.764	45.457	.03371	2987.	1000.	5000.	.482	116.
34	32	3.445	.356	7098.	-467.	2.601	7115.	-3.921	45.068	.03347	2983.	1000.	5000.	.656	157.
35	32	3.567	.399	7119.	-393.	2.610	7130.	-3.162	44.295	.03299	2974.	1000.	5000.	.849	202.
36	32	3.687	.441	7144.	-305.	2.622	7150.	-2.444	43.277	.03236	2963.	1000.	5000.	1.059	252.
37	32	3.804	.484	7170.	-223.	2.637	7174.	-1.778	42.134	.03165	2949.	1000.	5000.	1.277	304.
38	32	3.921	.528	7198.	-143.	2.655	7199.	-1.142	40.890	.03087	2935.	1000.	5000.	1.510	360.
39	32	4.035	.571	7226.	-68.	2.670	7226.	-.538	39.601	.03005	2919.	1000.	5000.	1.754	419.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
40	32	4.150	.619	7255.	5.	2.688	7255.	.041	38.282	.02922	2903.	1000.	5000.	2.011	481.
41	32	4.268	.666	7284.	78.	2.707	7285.	.610	36.925	.02835	2885.	1000.	5000.	2.286	547.
42	32	4.392	.719	7316.	152.	2.728	7318.	1.193	35.490	.02743	2866.	1000.	5000.	2.592	621.
43	32	4.534	.775	7352.	235.	2.753	7355.	1.831	33.883	.02639	2844.	1000.	5000.	2.954	710.
44	32	4.711	.854	7395.	334.	2.784	7405.	2.590	31.944	.02513	2816.	1000.	5000.	3.425	825.
45	32	4.953	.962	7452.	465.	2.828	7467.	3.570	29.436	.02347	2778.	1000.	5000.	4.097	990.
46	32	5.309	1.126	7533.	649.	2.893	7561.	4.926	26.045	.02120	2722.	1000.	5000.	5.141	1247.
47	32	5.882	1.382	7641.	906.	2.989	7694.	6.765	21.719	.01822	2641.	1000.	5000.	6.774	1650.
48	32	6.327	1.617	7723.	1117.	3.070	7802.	8.195	18.622	.01603	2574.	1000.	5000.	8.264	2017.
49	32	6.747	1.847	7790.	1291.	3.143	7897.	9.410	16.203	.01427	2515.	1000.	5000.	9.695	2369.
50	32	7.169	2.075	7847.	1449.	3.210	7980.	10.462	14.269	.01284	2462.	1000.	5000.	11.082	2707.
51	32	7.581	2.312	7896.	1590.	3.272	8055.	11.386	12.688	.01164	2415.	1000.	5000.	12.438	3035.
52	32	7.986	2.533	7939.	1718.	3.330	8123.	12.214	11.371	.01062	2371.	1000.	5000.	13.773	3354.
53	32	8.381	2.758	7975.	1831.	3.383	8183.	12.931	10.289	.00978	2332.	1000.	5000.	15.073	3661.
54	32	8.774	2.968	8006.	1955.	3.453	8239.	13.586	9.361	.00903	2295.	1000.	5000.	16.364	3961.
55	32	8.774	2.987	8008.	1931.	3.432	8217.	13.561	9.380	.00905	2296.	1000.	5000.	19.167	4661.
55	32	8.774	2.967	7469.	-161.	2.850	7471.	-1.234	25.699	.02051	2776.	878.	5000.	19.167	4661.
56	32	9.005	3.072	7501.	-78.	2.852	7502.	-.592	24.712	.01985	2757.	878.	5000.	20.919	5084.
57	32	9.256	3.162	7531.	0.	2.872	7531.	0.000	23.807	.01925	2740.	879.	5000.	22.808	5542.
57		F =	4940.3	FID =		4947.2	ETAF =	.9824	ISP =	242.166	ISPID =		244.042	ETAI =	.9523
26	33	3.123	.153	7712.	369.	3.008	7721.	2.738	20.924	.01766	2625.	1000.	5000.	.054	15.
27	33														
28	33														
29	33														
30	33														
31	33	3.197	.179	7080.	-1128.	2.625	7154.	-8.263	43.084	.03224	2960.	1000.	5000.	.098	25.
32	33	3.321	.212	7068.	-869.	2.605	7122.	-7.007	44.732	.03327	2979.	1000.	5000.	.195	48.
33	33	3.447	.249	7075.	-718.	2.598	7111.	-5.792	45.259	.03359	2985.	1000.	5000.	.316	76.
34	33	3.576	.289	7092.	-582.	2.601	7116.	-4.695	45.019	.03344	2982.	1000.	5000.	.461	110.
35	33	3.703	.331	7116.	-462.	2.610	7131.	-3.717	44.280	.03299	2974.	1000.	5000.	.626	149.
36	33	3.829	.375	7142.	-355.	2.623	7151.	-2.845	43.237	.03234	2962.	1000.	5000.	.808	192.
37	33	3.950	.419	7171.	-259.	2.638	7175.	-2.072	42.043	.03159	2948.	1000.	5000.	1.002	238.
38	33	4.070	.464	7200.	-171.	2.655	7202.	-1.357	40.739	.03077	2933.	1000.	5000.	1.211	288.
39	33	4.188	.509	7230.	-88.	2.673	7231.	-.697	39.391	.02992	2917.	1000.	5000.	1.432	341.
40	33	4.307	.556	7261.	-10.	2.692	7261.	-.076	38.016	.02905	2899.	1000.	5000.	1.667	396.
41	33	4.427	.605	7292.	67.	2.712	7292.	.525	36.607	.02815	2881.	1000.	5000.	1.921	459.
42	33	4.556	.657	7325.	145.	2.734	7326.	1.132	35.125	.02719	2861.	1000.	5000.	2.204	528.
43	33	4.702	.719	7362.	230.	2.760	7365.	1.790	33.473	.02613	2838.	1000.	5000.	2.543	611.
44	33	4.884	.797	7406.	332.	2.792	7414.	2.564	31.490	.02483	2810.	1000.	5000.	2.986	719.
45	33	5.131	.907	7466.	464.	2.837	7480.	3.556	28.944	.02314	2771.	1000.	5000.	3.623	875.
46	33	5.497	1.075	7548.	649.	2.903	7576.	4.915	25.527	.02084	2713.	1000.	5000.	4.622	1121.
47	33	6.042	1.336	7658.	906.	3.001	7711.	6.747	21.205	.01786	2631.	1000.	5000.	6.200	1511.
48	33	6.529	1.576	7741.	1111.	3.084	7821.	8.167	18.134	.01566	2563.	1000.	5000.	7.648	1868.
49	33	6.972	1.811	7810.	1289.	3.158	7916.	9.370	15.747	.01394	2503.	1000.	5000.	9.045	2211.
50	33	7.405	2.045	7868.	1446.	3.226	7999.	10.411	13.846	.01252	2450.	1000.	5000.	10.403	2542.
51	33	7.827	2.274	7917.	1586.	3.288	8074.	11.326	12.298	.01134	2402.	1000.	5000.	11.733	2863.
52	33	8.242	2.507	7960.	1713.	3.347	8142.	12.144	11.011	.01034	2358.	1000.	5000.	13.046	3176.
53	33	8.646	2.738	7997.	1824.	3.400	8202.	12.852	9.956	.00951	2319.	1000.	5000.	14.325	3477.
54	33														
55	33	8.983	2.933	8024.	1907.	3.441	8248.	13.371	9.209	.00891	2289.	1000.	5000.	17.398	4228.
55	33	8.983	2.933	7484.	-178.	2.841	7487.	-1.360	25.196	.02018	2767.	878.	5000.	17.398	4228.
56	33	9.188	3.003	7511.	-107.	2.859	7512.	-.818	24.382	.01963	2751.	878.	5000.	18.828	4574.
57	33	9.456	3.095	7541.	-28.	2.879	7541.	-.216	23.483	.01903	2734.	879.	5000.	20.689	5025.
58	33	9.618	3.162	7552.	0.	2.886	7552.	0.000	23.162	.01881	2727.	879.	5000.	22.006	5345.

I	J	X	Y	U	V	W	VMAG	THETA	P	RHO	T	PT	TT	RDOT	F
58		Y =	4860.0	FID =		4947.2	ETAF = .9824		ISP =	242.166	ISPID =	244.042		ETAI = .9923	
26	34	3.278	.105	7885.	248.	3.075	7809.	1.817	18.442	.01590	2578.	1000.	5000.	.814	5.
27	34														
28	34														
29	34														
30	34														
31	34														
32	34	3.432	.151	7056.	-1224.	2.629	7161.	-9.841	42.748	.03203	2957.	1000.	5000.	.078	20.
33	34	3.563	.185	7064.	-949.	2.608	7127.	-7.654	44.437	.03308	2976.	1000.	5000.	.171	41.
34	34	3.700	.224	7084.	-736.	2.605	7123.	-5.929	44.687	.03324	2979.	1000.	5000.	.286	68.
35	34	3.834	.266	7111.	-567.	2.612	7134.	-4.555	44.117	.03288	2972.	1000.	5000.	.422	100.
36	34	3.966	.312	7141.	-428.	2.625	7154.	-3.429	43.098	.03225	2961.	1000.	5000.	.576	137.
37	34	4.092	.358	7172.	-312.	2.640	7179.	-2.491	41.869	.03148	2946.	1000.	5000.	.744	176.
38	34	4.217	.400	7204.	-209.	2.658	7207.	-1.663	40.508	.03063	2930.	1000.	5000.	.928	220.
39	34	4.339	.446	7236.	-117.	2.677	7237.	-.925	39.098	.02974	2913.	1000.	5000.	1.125	268.
40	34	4.451	.494	7268.	-31.	2.697	7268.	-.248	37.665	.02882	2895.	1000.	5000.	1.337	319.
41	34	4.586	.543	7301.	50.	2.718	7301.	.394	36.204	.02789	2876.	1000.	5000.	1.568	375.
42	34	4.718	.597	7335.	132.	2.741	7337.	1.031	34.673	.02690	2855.	1000.	5000.	1.829	438.
43	34	4.868	.660	7374.	220.	2.767	7377.	1.712	32.978	.02580	2831.	1000.	5000.	2.143	515.
44	34	5.055	.740	7420.	325.	2.801	7427.	2.505	30.956	.02448	2802.	1000.	5000.	2.557	616.
45	34	5.310	.852	7481.	459.	2.847	7495.	3.508	28.377	.02277	2761.	1000.	5000.	3.158	763.
46	34	5.686	1.023	7566.	645.	2.916	7593.	4.871	24.943	.02045	2703.	1000.	5000.	4.109	998.
47	34	6.245	1.290	7678.	901.	3.016	7730.	6.697	20.639	.01746	2619.	1000.	5000.	5.626	1372.
48	34	6.737	1.535	7763.	1105.	3.096	7841.	8.105	17.604	.01529	2550.	1000.	5000.	7.029	1718.
49	34	7.200	1.775	7832.	1282.	3.175	7936.	9.297	15.258	.01357	2490.	1000.	5000.	8.390	2052.
50	34	7.645	2.011	7891.	1438.	3.243	8020.	10.327	13.396	.01218	2437.	1000.	5000.	9.716	2375.
51	34	8.078	2.246	7940.	1577.	3.307	8095.	11.232	11.884	.01102	2389.	1000.	5000.	11.019	2689.
52	34	8.583	2.485	7984.	1703.	3.365	8165.	12.042	10.629	.01004	2345.	1000.	5000.	12.305	2995.
53	34	8.918	2.718	8021.	1814.	3.419	8224.	12.742	9.604	.00923	2305.	1000.	5000.	13.561	3290.
54	34														
55	34	9.196	2.878	8044.	1880.	3.453	8260.	13.154	9.015	.00876	2281.	1000.	5000.	16.254	3948.
55	34	9.196	2.878	7501.	-199.	2.853	7504.	-1.521	24.649	.01981	2756.	878.	5000.	16.254	3948.
56	34	9.356	2.933	7523.	-142.	2.867	7524.	-1.081	24.007	.01938	2744.	878.	5000.	17.371	4219.
57	34	9.618	3.027	7553.	-62.	2.887	7553.	-.468	23.116	.01878	2727.	878.	5000.	19.202	4662.
58	34	9.803	3.093	7563.	-33.	2.895	7563.	-.247	22.800	.01857	2720.	879.	5000.	20.490	4975.
59	34	9.992	3.165	7575.	0.	2.903	7575.	0.000	22.443	.01833	2713.	879.	5000.	21.816	5297.
59		Y =	4860.0	FID =		4947.2	ETAF = .9824		ISP =	242.166	ISPID =	244.042		ETAI = .9923	
26	35	3.448	.054	7894.	125.	3.142	7895.	.904	16.245	.01430	2516.	1000.	5000.	-.009	-1.
27	35														
28	35														
29	35														
30	35														
31	35														
32	35	3.528	.074	6893.	-1597.	2.576	7075.	-13.045	47.143	.03475	3005.	1000.	5000.	.013	4.
33	35	3.482	.114	6930.	-968.	2.530	6998.	-7.955	51.395	.03735	3049.	1000.	5000.	.077	19.
34	35	3.424	.156	6978.	-626.	2.530	6998.	-5.129	51.399	.03735	3049.	1000.	5000.	.167	38.
35	35	3.959	.203	7011.	-408.	2.545	7023.	-3.329	50.003	.03650	3035.	1000.	5000.	.280	66.
36	35	4.089	.251	7051.	-252.	2.565	7056.	-2.049	48.183	.03539	3016.	1000.	5000.	.416	98.
37	35	4.213	.299	7090.	-133.	2.586	7091.	-1.073	46.293	.03423	2996.	1000.	5000.	.568	134.
38	35	4.335	.349	7128.	-32.	2.609	7128.	-.255	44.386	.03305	2975.	1000.	5000.	.739	175.
39	35	4.455	.398	7165.	56.	2.632	7165.	.451	42.531	.03190	2954.	1000.	5000.	.926	220.
40	35	4.574	.449	7201.	137.	2.655	7203.	1.086	40.727	.03076	2933.	1000.	5000.	1.130	269.
41	35	4.696	.502	7237.	212.	2.679	7240.	1.682	38.951	.02964	2911.	1000.	5000.	1.354	323.
42	35	4.825	.559	7274.	284.	2.704	7280.	2.271	37.139	.02849	2888.	1000.	5000.	1.610	385.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	WDOT	F
43	35	4.972	.624	7315.	470.	2.745	7325.	3.698	35.178	.02723	2862.	1000.	5000.	1.920	461.
44	35	5.154	.708	7365.	467.	2.769	7379.	3.630	32.886	.02574	2830.	1000.	5000.	2.332	562.
45	35	5.403	.824	7428.	592.	2.817	7452.	4.560	30.020	.02386	2787.	1000.	5000.	2.933	709.
46	35	5.770	1.001	7515.	766.	2.888	7554.	5.834	26.277	.02135	2726.	1000.	5000.	3.893	945.
47	35	6.316	1.275	7629.	1012.	2.990	7696.	7.559	21.666	.01818	2640.	1000.	5000.	5.432	1325.
48	35	6.796	1.524	7715.	1208.	3.075	7809.	8.900	18.452	.01590	2570.	1000.	5000.	6.862	1678.
49	35	7.244	1.767	7785.	1379.	3.150	7906.	10.04?	15.981	.01411	2509.	1000.	5000.	8.257	2019.
50	35	7.682	2.006	7843.	1530.	3.219	7991.	11.035	14.023	.01266	2455.	1000.	5000.	9.608	2349.
51	35	-------------------													
51	35	8.178	2.246	7940.	1577.	3.307	8095.	11.232	11.884	.01102	2389.	1000.	5000.	11.319	2689.
52	35	8.501	2.441	7984.	1703.	3.365	8163.	12.042	10.629	.01004	2345.	1000.	5000.	12.305	2995.
53	35	4.918	1.718	8021.	1814.	3.419	8224.	12.742	9.604	.00923	2305.	1000.	5000.	13.561	3290.
54	35														
55	35	9.196	2.876	8044.	1880.	3.453	8260.	13.154	9.015	.00876	2281.	1000.	5000.	13.561	3290.
55	35	9.196	2.874	7501.	-199.	2.853	7504.	-1.521	24.649	.01981	2756.	878.	5000.	13.561	3290.
56	35	9.356	2.933	7523.	-142.	2.867	7524.	-1.081	24.007	.01938	2744.	878.	5000.	17.371	4219.
57	35	9.616	3.027	7553.	-62.	2.887	7553.	-.468	23.116	.01878	2727.	878.	5000.	19.202	4662.
58	35	9.403	3.093	7563.	-33.	2.895	7563.	-.247	22.800	.01857	2720.	879.	5000.	20.490	4975.
59	35	9.992	3.162	7575.	0.	2.903	7575.	0.000	22.443	.01833	2713.	879.	5000.	21.816	5297.
26	36	3.699	1.002	7979.	0.	3.209	7979.	0.000	14.294	.01286	2463.	1000.	5000.	-.017	-3.
27	36														
28	36														
29	36														
30	36														
31	36														
32	36														
33	36	3.779	.055	6742.	-1265.	2.472	6899.	-10.565	57.195	.04083	3104.	1000.	5000.	.012	4.
34	36	3.928	.100	6857.	-565.	2.461	6880.	-4.708	58.322	.04150	3114.	1000.	5000.	.072	17.
35	36	4.065	.151	6920.	-269.	2.487	6925.	-2.226	55.585	.03987	3089.	1000.	5000.	.161	38.
36	36	4.194	.203	6975.	-98.	2.517	6976.	-.803	52.657	.03811	3061.	1000.	5000.	.276	65.
37	36	4.316	.254	7023.	21.	2.545	7023.	.171	49.988	.03649	3035.	1000.	5000.	.412	98.
38	36	4.426	.307	7068.	116.	2.572	7069.	.944	47.506	.03498	3009.	1000.	5000.	.570	135.
39	36	4.554	.359	7109.	190.	2.599	7112.	1.594	45.218	.03357	2984.	1000.	5000.	.745	177.
40	36	4.671	.412	7149.	271.	2.625	7154.	2.173	43.076	.03224	2960.	1000.	5000.	.947	224.
41	36	4.791	.467	7188.	341.	2.651	7196.	2.714	41.023	.03095	2936.	1000.	5000.	1.156	277.
42	36	4.917	.527	7228.	411.	2.678	7240.	3.250	38.974	.02966	2911.	1000.	5000.	1.404	337.
43	36	5.061	.595	7272.	496.	2.709	7288.	3.824	36.795	.02827	2884.	1000.	5000.	1.708	411.
44	36	5.241	.681	7325.	576.	2.747	7346.	4.497	34.289	.02666	2850.	1000.	5000.	2.115	511.
45	36	5.455	.801	7389.	693.	2.797	7421.	5.360	31.201	.02464	2805.	1000.	5000.	2.714	657.
46	36	5.846	.957	7478.	863.	2.869	7527.	6.557	27.225	.02199	2742.	1000.	5000.	3.674	894.
47	36	6.304	1.261	7594.	1094.	2.973	7672.	8.198	22.389	.01869	2654.	1000.	5000.	5.225	1276.
48	36	6.856	1.514	7680.	1283.	3.058	7787.	9.486	19.044	.01633	2584.	1000.	5000.	6.671	1633.
49	36	7.301	1.759	7751.	1449.	3.134	7885.	10.590	16.486	.01448	2522.	1000.	5000.	8.079	1978.
50	36	7.727	2.000	7810.	1596.	3.203	7971.	11.532	14.468	.01299	2468.	1000.	5000.	9.455	2312.
51	36	8.182	2.240	7860.	1728.	3.266	8047.	12.402	12.837	.01175	2419.	1000.	5000.	10.807	2638.
52	36	8.569	2.479	7903.	1849.	3.325	8116.	13.166	11.486	.01071	2375.	1000.	5000.	12.144	2957.
53	36	-------------------													
53	36	4.918	2.713	8021.	1814.	3.419	8224.	12.742	9.604	.00923	2305.	1000.	5000.	13.561	3290.
54	36														
55	36	9.196	2.876	8044.	1880.	3.453	8260.	13.154	9.015	.00876	2281.	1000.	5000.	13.561	3290.
55	36	9.196	2.878	7501.	-199.	2.853	7504.	-1.521	24.649	.01981	2756.	878.	5000.	13.561	3290.
56	36	9.356	2.933	7523.	-142.	2.867	7524.	-1.081	24.007	.01938	2744.	878.	5000.	17.371	4219.
57	36	9.618	3.027	7553.	-62.	2.887	7553.	-.468	23.116	.01878	2727.	878.	5000.	19.202	4662.
58	36	9.403	3.093	7563.	-33.	2.895	7563.	-.247	22.800	.01857	2720.	879.	5000.	20.490	4975.
59	36	9.992	3.162	7575.	0.	2.903	7575.	0.000	22.443	.01833	2713.	879.	5000.	21.816	5297.
13	37	3.459	0.000	5743.	0.	1.848	5743.	0.000	160.410	.09642	3686.	1000.	5000.	0.000	0.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	WDOT	F
34	37	3.983	.072	6255.	741.	2.150	6299.	6.758	102.259	.06626	3419.	1000.	5000.	.038	9.
35	37														
35	37	4.065	.151	6920.	-269.	2.487	6925.	-2.226	55.565	.03987	3089.	1000.	5000.	.161	38.
36	37	4.194	.203	6975.	-98.	2.517	6976.	-.803	52.657	.03811	3061.	1000.	5000.	.276	65.
37	37	4.316	.254	7023.	21.	2.545	7023.	.171	49.988	.03649	3035.	1000.	5000.	.412	98.
38	37	4.436	.307	7068.	116.	2.572	7069.	.944	47.506	.03498	3009.	1000.	5000.	.570	135.
39	37	4.554	.359	7109.	198.	2.599	7112.	1.594	45.218	.03357	2984.	1000.	5000.	.745	177.
40	37	4.671	.412	7149.	271.	2.625	7154.	2.173	43.076	.03224	2960.	1000.	5000.	.940	224.
41	37	4.791	.467	7188.	341.	2.651	7196.	2.714	41.023	.03095	2936.	1000.	5000.	1.156	277.
42	37	4.917	.527	7228.	411.	2.678	7240.	3.250	38.974	.02966	2911.	1000.	5000.	1.404	337.
43	37	5.061	.595	7272.	486.	2.709	7288.	3.824	36.795	.02827	2884.	1000.	5000.	1.708	411.
44	37	5.241	.681	7323.	576.	2.747	7346.	4.497	34.289	.02665	2850.	1000.	5000.	2.115	511.
45	37	5.489	.801	7389.	693.	2.797	7421.	5.360	31.201	.02464	2805.	1000.	5000.	2.714	657.
46	37	5.843	.982	7478.	860.	2.869	7527.	6.557	27.225	.02199	2742.	1000.	5000.	3.674	894.
47	37	6.384	1.261	7594.	1094.	2.973	7672.	8.198	22.389	.01869	2654.	1000.	5000.	5.225	1276.
48	37	6.856	1.514	7680.	1283.	3.058	7787.	9.486	19.044	.01633	2584.	1000.	5002.	6.671	1633.
49	37	7.301	1.759	7751.	1449.	3.134	7885.	10.590	16.486	.01448	2522.	1000.	5000.	8.079	1978.
50	37	7.727	2.000	7810.	1596.	3.203	7971.	11.552	14.468	.01299	2468.	1000.	5000.	9.455	2312.
51	37	8.142	2.240	7860.	1728.	3.266	8047.	12.402	12.837	.01175	2419.	1000.	5000.	10.807	2638.
52	37	8.549	2.479	7903.	1849.	3.325	8116.	13.166	11.486	.01071	2375.	1000.	5000.	12.144	2957.
53	37	8.918	2.718	8021.	1814.	3.419	8224.	12.742	9.604	.00923	2305.	1000.	5000.	13.561	3290.
54	37														
55	37	9.196	2.876	8044.	1880.	3.453	8260.	13.154	9.015	.00876	2281.	1000.	5000.	13.561	3290.
55	37	9.196	2.878	7501.	-199.	2.853	7504.	-1.521	24.649	.01981	2756.	878.	5000.	13.561	3290.
56	37	9.356	2.933	7523.	-142.	2.867	7524.	-1.081	24.007	.01938	2744.	878.	5000.	17.371	4219.
57	37	9.618	3.027	7553.	-62.	2.887	7553.	-.468	23.116	.01878	2727.	878.	5000.	19.202	4662.
58	37	9.803	3.093	7563.	-33.	2.895	7563.	-.247	22.800	.01857	2720.	879.	5000.	20.490	4975.
59	37	9.992	3.142	7575.	0.	2.903	7575.	0.000	22.443	.01833	2713.	879.	5000.	21.816	5297.
34	38	4.160	0.000	7068.	0.	2.572	7068.	0.000	47.551	.03500	3010.	1000.	5000.	0.000	0.
35	38	4.274	.047	6813.	-284.	2.427	6819.	-2.384	62.165	.04376	3147.	1000.	5000.	.016	4.
36	38	4.413	.106	6912.	26.	2.479	6912.	.212	56.410	.04036	3096.	1000.	5000.	.073	17.
37	38	4.538	.163	6981.	153.	2.521	6983.	1.256	52.238	.03786	3057.	1000.	5000.	.160	38.
38	38	4.660	.219	7039.	240.	2.557	7043.	1.953	48.896	.03583	3024.	1000.	5000.	.273	65.
39	38	4.779	.275	7089.	311.	2.589	7096.	2.509	46.068	.03409	2994.	1000.	5000.	.409	97.
40	38	4.898	.331	7135.	374.	2.619	7145.	2.999	43.560	.03254	2966.	1000.	5000.	.566	136.
41	38	5.018	.389	7179.	434.	2.648	7192.	3.459	41.243	.03109	2939.	1000.	5000.	.748	180.
42	38	5.147	.451	7222.	495.	2.678	7239.	3.920	38.994	.02967	2912.	1000.	5000.	.962	232.
43	38	5.293	.522	7269.	562.	2.711	7291.	4.422	36.654	.02818	2882.	1000.	5000.	1.230	297.
44	38	5.475	.611	7324.	643.	2.751	7352.	5.020	34.012	.02648	2846.	1000.	5000.	1.597	387.
45	38	5.723	.735	7395.	751.	2.804	7431.	5.801	30.813	.02438	2800.	1000.	5000.	2.147	522.
46	38	6.091	.922	7485.	907.	2.876	7540.	6.907	26.761	.02168	2735.	1000.	5000.	3.046	743.
47	38	6.649	1.210	7605.	1130.	2.984	7688.	8.454	21.903	.01835	2645.	1000.	5000.	4.524	1108.
48	38	7.121	1.478	7693.	1313.	3.071	7804.	9.684	18.580	.01600	2573.	1000.	5000.	5.920	1452.
49	38	7.576	1.721	7764.	1473.	3.148	7903.	10.745	16.053	.01416	2511.	1000.	5000.	7.290	1787.
50	38	8.011	1.968	7824.	1617.	3.218	7989.	11.674	14.070	.01269	2457.	1000.	5000.	8.635	2113.
51	38	8.434	2.212	7874.	1745.	3.281	8066.	12.497	12.471	.01147	2408.	1000.	5000.	9.960	2432.
52	38	8.859	2.457	7918.	1863.	3.340	8135.	13.240	11.150	.01045	2363.	1000.	5000.	11.275	2744.
53	38	9.253	2.696	7956.	1965.	3.393	8195.	13.875	10.087	.00961	2324.	1000.	5000.	12.548	3043.
54	38														
55	38	9.447	2.814	7972.	2010.	3.417	8222.	14.148	9.636	.00926	2306.	1000.	5000.	15.069	3659.
55	38	9.447	2.814	7466.	-59.	2.827	7466.	-.452	26.002	.02075	2779.	883.	5000.	15.069	3659.
56	38	9.558	2.856	7480.	-19.	2.837	7480.	-.146	25.509	.02039	2771.	881.	5000.	15.868	3853.
57	38	9.816	2.933	7509.	60.	2.856	7509.	.460	24.535	.01974	2754.	880.	5001.	17.736	4306.
58	38	9.996	3.023	7519.	88.	2.864	7520.	.674	24.183	.01950	2748.	879.	5001.	19.045	4623.
59	38	12.181	3.094	7531.	120.	2.872	7532.	.913	23.788	.01923	2740.	879.	5001.	20.392	4951.
60	38	13.339	3.142	7487.	0.	2.842	7487.	0.000	25.201	.02018	2766.	879.	5000.	21.713	5273.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
60		X = 4460.9	F1D =			4947.2	ETAF = .9824		ISP = 242.166		ISPID = 244.042			ETAI = .9923	
35	39	4.370	0.000	6561.	0.	2.285	6561.	0.000	80.344	.05419	3284.	1000.	5000.	0.000	0.
36	39	4.504	.057	6582.	309.	2.424	6815.	2.599	62.452	.04393	3149.	1000.	5000.	.026	6.
37	39	4.626	.128	6911.	361.	2.445	6921.	2.987	55.861	.04003	3091.	1000.	5000.	.093	22.
38	39	4.744	.187	6953.	426.	2.528	6995.	3.330	51.553	.03744	3050.	1000.	5000.	.190	45.
39	39	4.861	.245	7047.	452.	2.565	7096.	3.672	48.173	.03538	3016.	1000.	5000.	.313	75.
40	39	4.977	.306	7093.	498.	2.598	7111.	4.016	45.302	.03362	2985.	1000.	5000.	.459	110.
41	39	5.099	.365	7141.	545.	2.629	7162.	4.368	42.723	.03202	2956.	1000.	5000.	.632	152.
42	39	5.221	.427	7148.	596.	2.661	7212.	4.742	40.267	.03047	2927.	1000.	5000.	.836	202.
43	39	5.363	.490	7237.	654.	2.695	7267.	5.166	37.749	.02888	2896.	1000.	5000.	1.099	266.
44	39	5.545	.591	7294.	727.	2.737	7330.	5.692	34.943	.02708	2859.	1000.	5000.	1.458	354.
45	39	5.799	.718	7365.	824.	2.790	7412.	6.400	31.582	.02489	2811.	1000.	5000.	2.002	487.
46	39	6.153	.908	7440.	973.	2.866	7523.	7.430	27.367	.02209	2745.	1000.	5000.	2.897	708.
47	39	6.696	1.199	7591.	1189.	2.973	7673.	8.903	22.360	.01867	2654.	1000.	5000.	4.378	1073.
48	39	7.172	1.462	7679.	1365.	3.051	7790.	10.089	18.953	.01626	2582.	1000.	5000.	5.782	1418.
49	39	7.622	1.715	7742.	1522.	3.118	7890.	11.119	16.369	.01439	2519.	1000.	5000.	7.162	1756.
50	39	8.092	1.963	7802.	1662.	3.207	7977.	12.025	14.345	.01289	2465.	1000.	5000.	8.518	2085.
51	39	8.471	2.209	7852.	1788.	3.271	8053.	12.831	12.715	.01166	2416.	1000.	5000.	9.856	2407.
52	39	8.882	2.454	7896.	1904.	3.330	8123.	13.559	11.370	.01062	2371.	1000.	5000.	11.182	2722.
53	39	----------------------													
53	39	9.252	2.696	7926.	1965.	3.393	8195.	13.875	10.087	.00961	2324.	1000.	5060.	12.548	3043.
54	39														
55	39	9.447	2.914	7972.	2013.	3.417	8222.	14.188	9.636	.00926	2306.	1000.	5000.	12.548	3043.
55	39	9.447	2.914	7466.	-59.	2.827	7466.	-.452	26.002	.02073	2779.	883.	5000.	12.548	3043.
56	39	9.553	2.856	7480.	-19.	2.837	7480.	-.146	25.509	.02039	2771.	881.	5000.	15.868	3853.
57	39	9.414	2.955	7509.	60.	2.856	7509.	.460	24.535	.01974	2754.	880.	5001.	17.738	4306.
58	39	9.996	3.023	7519.	88.	2.864	7520.	.674	24.193	.01950	2748.	879.	5001.	19.045	4623.
59	39	10.181	3.094	7531.	120.	2.872	7532.	.913	23.788	.01923	2740.	879.	5001.	20.392	4951.
60	39	10.159	3.162	7487.	0.	2.842	7487.	0.000	25.201	.02018	2766.	879.	5000.	21.71?	5273.
36	40	4.669	0.000	7094.	0.	2.598	7094.	0.000	46.153	.03414	2995.	1000.	5000.	0.000	0.
37	40	4.805	.057	7130.	43.	2.610	7130.	.343	44.305	.03300	2974.	1000.	5000.	.017	4.
38	40	4.939	.114	7178.	112.	2.640	7179.	.898	41.862	.03148	2946.	1000.	5000.	.064	15.
39	40	5.069	.170	7224.	176.	2.670	7227.	1.394	39.596	.03005	2919.	1000.	5000.	.136	33.
40	40	5.198	.226	7268.	232.	2.699	7272.	1.850	37.524	.02873	2893.	1000.	5000.	.233	56.
41	40	5.330	.284	7310.	292.	2.727	7316.	2.290	35.576	.02749	2867.	1000.	5000.	.353	86.
42	40	5.470	.346	7352.	352.	2.757	7361.	2.740	33.662	.02625	2841.	1000.	5000.	.505	123.
43	40	5.630	.418	7398.	418.	2.789	7410.	3.235	31.653	.02494	2812.	1000.	5000.	.703	171.
44	40	5.829	.508	7452.	499.	2.829	7469.	3.831	29.370	.02343	2777.	1000.	5000.	.985	240.
45	40	6.101	.633	7521.	607.	2.882	7545.	4.613	26.588	.02156	2732.	1000.	5000.	1.423	348.
46	40	6.505	.823	7613.	765.	2.957	7651.	5.725	23.047	.01914	2667.	1000.	5000.	2.168	532.
47	40	7.109	1.117	7733.	988.	3.065	7796.	7.283	18.794	.01615	2578.	1000.	5000.	3.435	845.
48	40	7.649	1.383	7822.	1172.	3.153	7910.	8.518	15.890	.01404	2507.	1000.	5000.	4.661	1146.
49	40	8.142	1.643	7895.	1331.	3.232	8007.	9.583	13.688	.01240	2445.	1000.	5000.	5.882	1445.
50	40	8.623	1.897	7956.	1477.	3.303	8091.	10.514	11.963	.01108	2391.	1000.	5000.	7.093	1738.
51	40	9.091	2.150	8007.	1606.	3.368	8166.	11.339	10.578	.01000	2343.	1000.	5000.	8.296	2025.
52	40	9.550	2.403	8051.	1724.	3.428	8234.	12.083	9.437	.00910	2298.	1000.	5000.	9.494	2307.
53	40	9.993	2.649	8089.	1824.	3.482	8292.	12.710	8.529	.00836	2260.	1000.	5000.	10.651	2574.
54	40														
55	40	10.024	2.668	8092.	1831.	3.486	8296.	12.752	8.469	.00831	2257.	1000.	5000.	16.392	3980.
55	40	10.024	2.668	7547.	-238.	2.885	7550.	-1.805	23.176	.01882	2728.	878.	5000.	16.392	3980.
56	40														
57	40	10.313	2.766	7582.	-145.	2.908	7583.	-1.098	22.221	.01817	2709.	879.	5001.	19.166	4410.
58	40	10.507	2.833	7593.	-114.	2.916	7594.	-.859	21.914	.01796	2703.	879.	5001.	19.354	4698.
59	40	10.706	2.933	7606.	-79.	2.924	7606.	-.594	21.565	.01772	2696.	879.	5002.	20.583	4597.
60	40	10.876	2.962	7559.	-200.	2.892	7561.	-1.519	22.933	.01865	2725.	879.	5003.	21.656	5259.
61	40	11.449	3.162	7630.	0.	2.942	7630.	0.000	20.844	.01723	2680.	879.	4999.	25.560	6204.

I	J	X	Y	U	V	W	VMAG	THETA	P	RHO	T	PT	TT	HDOT	F
61		F =	4440.8	FID =		4947.2	ETAF = .9824		ISP = 242.166		ISPID = 244.042			ETAI = .9923	
37	41	4.945	0.000	7165.	0.	2.632	7165.	0.000	42.532	.03190	2954.	1000.	5000.	0.000	0.
38	41	5.083	.057	7221.	70.	2.667	7222.	.558	39.820	.03019	2922.	1000.	5000.	.015	4.
39	41	5.218	.115	7270.	130.	2.698	7271.	1.024	37.545	.02876	2893.	1000.	5000.	.058	14.
40	41	5.352	.170	7314.	186.	2.728	7317.	1.459	35.524	.02745	2867.	1000.	5000.	.126	30.
41	41	5.489	.228	7357.	242.	2.757	7361.	1.885	33.643	.02624	2841.	1000.	5000.	.218	53.
42	41	5.635	.291	7400.	300.	2.787	7406.	2.325	31.803	.02503	2814.	1000.	5000.	.340	83.
43	41	5.800	.363	7446.	366.	2.820	7455.	2.812	29.879	.02377	2785.	1000.	5000.	.506	123.
44	41	6.007	.450	7501.	446.	2.860	7514.	3.400	27.696	.02231	2750.	1000.	5000.	.749	183.
45	41	6.294	.562	7570.	553.	2.913	7590.	4.177	25.062	.02051	2704.	1000.	5000.	1.138	279.
46	41	6.710	.772	7663.	709.	2.990	7696.	5.283	21.670	.01818	2640.	1000.	5000.	1.813	446.
47	41	7.339	1.064	7784.	933.	3.099	7840.	6.836	17.629	.01531	2551.	1000.	5000.	2.987	736.
48	41	7.893	1.338	7874.	1116.	3.188	7953.	8.068	14.877	.01329	2480.	1000.	5000.	4.139	1019.
49	41	8.416	1.601	7948.	1277.	3.268	8049.	9.151	12.795	.01172	2418.	1000.	5000.	5.297	1301.
50	41	8.934	1.860	8008.	1421.	3.339	8134.	10.060	11.168	.01047	2364.	1000.	5000.	6.450	1579.
51	41	9.437	2.116	8060.	1550.	3.405	8208.	10.883	9.863	.00944	2315.	1000.	5000.	7.600	1853.
52	41	9.887	2.373	8105.	1667.	3.466	8275.	11.625	8.790	.00857	2271.	1000.	5000.	8.749	2122.
53	41	10.348	2.623	8143.	1768.	3.520	8335.	12.249	7.938	.00788	2233.	1000.	5000.	9.861	2378.
54	41														
55	41	12.385	2.595	8139.	1755.	3.514	8326.	12.171	8.033	.00795	2238.	1000.	5000.	11.886	2891.
55	41	12.293	2.599	7578.	-315.	2.909	7584.	-2.362	22.104	.01808	2708.	876.	5000.	11.886	2891.
56	41														
57	41	12.543	2.676	7608.	-234.	2.929	7612.	-1.758	21.349	.01757	2692.	877.	5000.	13.295	3233.
58	41	12.743	2.767	7633.	-205.	2.956	7625.	-1.506	21.059	.01737	2686.	878.	5001.	14.433	3509.
59	41	13.984	2.833	7613.	-164.	2.945	7615.	-1.227	20.728	.01714	2678.	878.	5001.	15.612	3796.
60	41	11.114	2.864	[illegible]	-286.	2.912	7589.	-2.160	22.080	.01807	2708.	879.	5005.	16.585	4035.
61	41	11.712	3.066	[illegible]	-79.	2.963	7649.	-.593	20.058	.01669	2663.	879.	5001.	20.384	4952.
62	41	11.956	3.162	[illegible]	0.	2.983	7646.	0.000	19.299	.01616	2645.	879.	4999.	22.075	5364.
62		F =	4446.8	FID =		4947.	ETAF = .9824		ISP = 242.166		ISPID = 244.042			ETAI = .9923	
38	42	5.238	0.000	7279.	0.	2.705	7279.	0.000	37.204	.02853	2889.	1000.	5000.	0.000	0.
39	42	5.368	.056	7325.	59.	2.734	7326.	.464	35.147	.02721	2862.	1000.	5000.	.013	3.
40	42	5.593	.113	7369.	116.	2.763	7370.	.904	33.277	.02600	2836.	1000.	5000.	.055	15.
41	42	5.691	.171	7411.	173.	2.791	7413.	1.337	31.520	.02485	2810.	1000.	5000.	.117	28.
42	42	5.853	.234	7454.	237.	2.821	7457.	1.781	29.795	.02371	2784.	1000.	5000.	.209	51.
43	42	5.975	.304	7500.	298.	2.855	7506.	2.272	27.985	.02250	2755.	1000.	5000.	.343	84.
44	42	6.198	.387	7554.	378.	2.895	7564.	2.865	25.929	.02112	2720.	1000.	5000.	.547	134.
45	42	6.485	.524	7624.	486.	2.949	7639.	3.646	23.426	.01940	2675.	1000.	5000.	.885	217.
46	42	6.926	.717	7717.	642.	3.026	7744.	4.759	20.244	.01718	2610.	1000.	5000.	1.488	366.
47	42	7.581	1.016	7859.	868.	3.136	7887.	6.518	16.433	.01444	2521.	1000.	5000.	2.564	632.
48	42	8.168	1.298	7938.	1051.	3.226	8000.	7.551	13.843	.01252	2450.	1000.	5000.	3.639	896.
49	42	8.708	1.556	8004.	1213.	3.306	8095.	8.615	11.087	.01102	2389.	1000.	5000.	4.729	1161.
50	42	9.256	1.818	8065.	1356.	3.379	8179.	9.545	10.361	.00983	2335.	1000.	5000.	5.821	1424.
51	42	9.765	2.079	8118.	1487.	3.445	8252.	10.368	9.139	.00886	22 6.	1000.	5000.	6.915	1683.
52	42	10.248	2.347	8165.	1665.	3.507	8339.	11.109	8.136	.00804	22 2.	1000.	5000.	8.012	1939.
53	42														
54	42														
55	42	11.582	2.516	8198.	1671.	3.544	8359.	11.534	7.579	.00758	2216.	1000.	5000.	10.728	2606.
55	42	11.582	2.516	7610.	-397.	2.935	7620.	-2.989	20.998	.01732	2686.	874.	5000.	10.729	2606.
56	42														
57	42	13.784	2.578	7655.	-333.	2.950	7662.	-2.497	20.436	.01694	2673.	875.	5000.	11.781	2861.
58	42	14.991	2.643	7647.	-298.	2.958	7653.	-2.229	20.166	.01675	2667.	877.	5001.	12.866	3124.
59	42	11.265	2.711	7661.	-259.	2.967	7665.	-1.934	19.855	.01654	2660.	877.	5001.	13.993	3398.
60	42	11.165	2.761	7616.	-382.	2.933	7619.	-2.875	21.190	.01746	2689.	878.	5003.	14.866	3611.
61	42	11.401	2.963	7687.	-168.	2.984	7689.	-1.252	19.243	.01611	2646.	879.	5002.	18.549	4502.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
62	42	12.277	3.057	7716.	-86.	3.005	7716.	-.637	18.511	.01561	2628.	879.	5000.	20.184	4900.
63	42	12.581	3.162	7746.	0.	3.027	7746.	0.000	17.751	.01507	2609.	879.	4999.	21.925	5325.
63		F =	4860.0	F1D =		4947.2	ETAF = .9824		ISP =	242.166	ISP1D =	244.042		ETAI = .9923	
39	43	5.514	0.000	7372.	- 0.	2.764	7372.	0.000	33.182	.02594	2834.	1000.	5000.		
40	43	5.659	.057	7416.	57.	2.793	7416.	.440	31.413	.02478	2809.	1000.	5000.	0.000	0.
41	43	5.907	.115	7458.	114.	2.822	7459.	.873	29.745	.02368	2783.	1000.	5000.	.013	3.
42	43	5.964	.178	7501.	173.	2.852	7503.	1.318	28.107	.02259	2757.	1000.	5000.	.050	12.
43	43	6.143	.250	7547.	238.	2.886	7551.	1.810	26.387	.02143	2728.	1000.	5000.	.116	28.
44	43	6.367	.341	7602.	319.	2.926	7608.	2.404	24.433	.02010	2693.	1000.	5000.	.219	54.
45	43	6.673	.469	7671.	427.	2.981	7683.	3.186	22.054	.01845	2648.	1000.	5000.	.387	95.
46	43	7.129	.663	7765.	584.	3.058	7787.	4.300	19.031	.01632	2584.	1000.	5000.	.677	167.
47	43	7.813	.965	7888.	810.	3.169	7930.	5.861	15.414	.01369	2494.	1000.	5000.	1.215	300.
48	43	8.416	1.241	7980.	993.	3.261	8041.	7.095	12.962	.01185	2423.	1000.	5000.	2.201	543.
49	43	8.987	1.511	8054.	1155.	3.342	8136.	8.158	11.114	.01042	2362.	1000.	5000.	3.205	789.
50	43	9.536	1.777	8116.	1298.	3.415	8219.	9.087	9.675	.00929	2308.	1000.	5000.	4.232	1030.
51	43	10.069	2.041	8169.	1427.	3.492	8293.	9.909	8.524	.00836	2260.	1000.	5000.	5.269	1287.
52	43	10.594	2.306	8214.	1545.	3.544	8358.	10.650	7.581	.00758	2216.	1000.	5000.	6.312	1534.
53	43													7.361	1777.
54	43														
55	43	10.853	2.439	8235.	1595.	3.573	8388.	10.964	7.188	.00725	2197.	1000.	5000.	9.542	2313.
55	43	10.853	2.439	7637.	-475.	2.958	7652.	-3.561	20.054	.01666	2667.	871.	5000.	9.542	2313.
56	43														
57	43	11.009	2.485	7656.	-426.	2.970	7668.	-3.181	19.655	.01639	2657.	873.	5000.	10.292	2495.
58	43	11.223	2.549	7669.	-388.	2.977	7679.	-2.896	19.404	.01622	2651.	875.	5000.	11.330	2746.
59	43	11.442	2.615	7684.	-347.	2.986	7691.	-2.585	19.111	.01602	2643.	876.	5001.	12.410	3009.
60	43	11.599	2.662	7630.	-471.	2.951	7645.	-3.533	20.432	.01693	2674.	877.	5002.	13.196	3200.
61	43	12.252	2.861	7711.	-249.	3.003	7715.	-1.852	18.551	.01563	2630.	878.	5002.	16.772	4065.
62	43	12.549	2.956	7741.	-164.	3.024	7743.	-1.216	17.843	.01513	2612.	878.	5001.	18.356	4451.
63	43	12.866	3.061	7771.	-76.	3.046	7772.	-.557	17.107	.01461	2593.	879.	5000.	20.044	4862.
64	43	13.162	3.162	7797.	0.	3.066	7797.	0.000	16.483	.01417	2577.	879.	4999.	21.619	5247.
64		F =	4860.0	F1D =		4947.2	ETAF = .9824		ISP =	242.166	ISP1D =	244.042		ETAI = .9923	
40	44	5.809	0.000	7460.	0.	2.923	7460.	0.000	29.714	.02366	2783.	1000.	5000.	0.000	0.
41	44	5.962	.058	7502.	57.	2.852	7502.	.432	28.129	.02260	2757.	1000.	5000.	.012	3.
42	44	6.125	.121	7545.	116.	2.882	7546.	.878	26.570	.02155	2731.	1000.	5000.	.051	13.
43	44	6.311	.194	7591.	182.	2.916	7593.	1.370	24.932	.02044	2702.	1000.	5000.	.126	31.
44	44	6.543	.285	7646.	262.	2.957	7650.	1.964	23.070	.01916	2668.	1000.	5000.	.259	64.
45	44	6.861	.413	7716.	370.	3.011	7725.	2.748	20.804	.01758	2622.	1000.	5000.	.503	124.
46	44	7.333	.609	7811.	527.	3.090	7829.	3.863	17.926	.01553	2558.	1000.	5000.	.978	241.
47	44	8.044	.913	7935.	754.	3.202	7970.	5.426	14.487	.01300	2469.	1000.	5000.	1.878	463.
48	44	8.672	1.192	8027.	937.	3.294	8081.	6.659	12.163	.01124	2398.	1000.	5000.	2.812	692.
49	44	9.266	1.465	8102.	1098.	3.376	8176.	7.721	10.413	.00987	2336.	1000.	5000.	3.780	927.
50	44	9.837	1.734	8164.	1242.	3.450	8258.	8.650	9.053	.00879	2283.	1000.	5000.	4.764	1162.
51	44	10.392	2.002	8217.	1371.	3.518	8331.	9.470	7.968	.00790	2235.	1000.	5000.	5.757	[illegible]
52	44	10.938	2.271	8263.	1488.	3.581	8396.	10.210	7.079	.00716	2191.	1000.	5000.	6.761	1627.
53	44														
54	44														
55	44	11.120	2.361	8277.	1522.	3.600	8416.	10.419	6.829	.00695	2178.	1000.	5000.	8.521	2060.
55	44	11.120	2.361	7662.	-552.	2.979	7682.	-4.120	19.196	.01606	2649.	869.	5000.	8.521	2060.
56	44														
57	44	11.228	2.391	7675.	-517.	2.987	7692.	-3.855	18.941	.01588	2642.	870.	5000.	9.002	2176.
58	44	11.449	2.454	7689.	-477.	2.995	7703.	-3.551	18.708	.01572	2636.	872.	5000.	9.995	2417.
59	44	11.675	2.519	7703.	-434.	3.004	7716.	-3.222	18.433	.01554	2628.	874.	5000.	11.029	2668.

I	J	X	R	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	WDOT	F
40	44	11.837	2.567	7648.	-554.	2.969	7668.	-4.170	19.742	.01645	2659.	875.	5002.	11.757	2841.
41	44	12.508	2.760	7732.	-329.	3.021	7739.	-2.434	17.925	.01518	2616.	877.	5002.	15.208	3680.
42	44	12.816	2.855	7765.	-241.	3.042	7767.	-1.775	17.240	.01470	2598.	878.	5002.	16.742	4053.
43	44	13.145	2.960	7795.	-149.	3.064	7796.	-1.094	16.526	.01420	2579.	878.	5001.	18.379	4452.
44	44	13.452	3.061	7821.	-71.	3.084	7821.	-.518	15.921	.01376	2562.	879.	5000.	19.906	4825.
45	44	13.753	3.162	7845.	0.	3.103	7845.	0.000	15.375	.01337	2547.	879.	4999.	21.404	5191.

53 F = [illegible] F1D = 4947.2 ETAF = .9824 ISP = 242.166 ISP1D = 244.042 ETAI = .9923

I	J	X	R	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	WDOT	F
41	45	6.121	0.000	7544.	0.	2.881	7544.	0.000	26.608	.02158	2732.	1000.	5000.	0.000	0.
42	45	6.293	.063	7587.	59.	2.912	7588.	.445	25.124	.02057	2706.	1000.	5000.	.013	3.
43	45	6.482	.135	7654.	125.	2.946	7655.	.937	23.563	.01950	2677.	1000.	5000.	.059	14.
44	45	6.722	.227	7689.	206.	2.987	7692.	1.532	21.789	.01827	2642.	1000.	5000.	.157	39.
45	45	7.251	.356	7759.	314.	3.042	7766.	2.316	19.630	.01675	2597.	1000.	5000.	.356	88.
46	45	7.982	.553	7855.	471.	3.121	7869.	3.435	16.888	.01477	2533.	1000.	5000.	.766	190.
47	45	8.301	.659	7980.	698.	3.215	8010.	4.996	13.618	.01235	2443.	1000.	5000.	1.583	391.
48	45	8.933	1.141	8072.	881.	3.328	8120.	6.229	11.414	.01066	2373.	1000.	5000.	2.449	603.
49	45	9.551	1.417	8148.	1142.	3.411	8214.	7.290	9.758	.00935	2311.	1000.	5000.	3.358	822.
50	45	10.149	1.689	8211.	1146.	3.495	8296.	8.217	8.473	.00831	2258.	1000.	5000.	4.288	1044.
51	45	10.722	1.962	8264.	1314.	3.554	8368.	9.037	7.449	.00747	2210.	1000.	5000.	5.234	1265.
52	45	11.292	2.231	8311.	1437.	3.617	8433.	9.776	6.612	.00676	2166.	1000.	5000.	6.192	1484.
53	45														
54	45														
55	45	11.109	2.289	8318.	1449.	3.627	8443.	9.883	6.489	.00666	2159.	1000.	5000.	7.596	1830.
55	45	11.139	2.206	7606.	-629.	3.300	7710.	-4.682	18.392	.01548	2631.	866.	5000.	7.596	1830.
56	45														
57	45	11.467	2.295	7631.	-611.	3.004	7715.	-4.541	18.268	.01540	2628.	867.	5000.	7.831	1887.
58	45	11.670	2.336	7705.	-568.	3.012	7726.	-4.217	18.054	.01526	2622.	869.	5000.	8.780	2117.
59	45	11.908	2.423	7731.	-523.	3.021	7738.	-3.868	17.797	.01508	2614.	872.	5000.	9.769	2357.
60	45	12.882	2.467	7663.	-648.	2.985	7690.	-4.832	19.095	.01599	2645.	873.	5002.	10.403	2512.
61	45	12.764	2.656	7751.	-409.	3.047	7762.	-3.01P	17.342	.01477	2602.	876.	5002.	13.769	3325.
62	45	13.185	2.731	7781.	-317.	3.059	7789.	-2.333	16.68C	.01430	2584.	877.	5002.	15.254	3686.
63	45	13.427	2.854	7816.	-222.	3.081	7819.	-1.627	15.987	.01381	2565.	878.	5001.	16.839	4072.
64	45	13.745	2.954	7842.	-141.	3.102	7844.	-1.031	15.399	.01338	2549.	878.	5001.	18.317	4433.
65	45	14.057	3.058	7867.	-64.	3.120	7868.	-.494	14.869	.01300	2533.	879.	5000.	19.768	4788.
66	45	14.372	3.162	7890.	0.	3.138	7890.	0.000	14.377	.01265	2519.	879.	4995.	21.237	5147.

46 F = [illegible] F1D = 4947.2 ETAF = .9824 ISP = 242.166 ISP1D = 244.042 ETAI = .9923

I	J	X	R	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	WDOT	F
42	46	6.650	0.000	7631.	0.	2.942	7631.	0.000	23.701	.01959	2680.	1000.	5000.	0.000	0.
43	46	6.664	.073	7677.	66.	2.977	7678.	.492	22.218	.01857	2651.	1000.	5000.	.016	4.
44	46	6.917	.165	7733.	147.	3.010	7734.	1.087	20.530	.01738	2616.	1000.	5000.	.079	15.
45	46	7.259	.294	7834.	255.	3.074	7808.	1.872	18.477	.01592	2571.	1000.	5000.	.231	57.
46	46	7.762	.491	7900.	413.	3.154	7911.	2.990	15.870	.01403	2507.	1000.	5000.	.578	143.
47	46	8.523	.820	8025.	639.	3.269	8051.	4.553	12.768	.01170	2417.	1000.	5000.	1.304	322.
48	46	9.212	1.247	8112.	822.	3.363	8160.	5.764	10.682	.01009	2346.	1000.	5000.	2.100	516.
49	46	9.856	1.563	8195.	984.	3.447	8254.	6.845	9.118	.00884	2285.	1000.	5000.	2.947	721.
50	46	10.475	1.639	8258.	1127.	3.522	8335.	7.771	7.907	.00785	2232.	1000.	5000.	3.823	923.
51	46	11.077	1.914	8312.	1256.	3.591	8407.	8.589	6.944	.00704	2184.	1000.	5000.	4.719	1137.
52	46	11.672	2.192	8359.	1373.	3.655	8471.	9.327	6.157	.00637	2141.	1000.	5000.	5.631	1344.
53	46														
54	46														
55	46	11.674	2.192	8359.	1371.	3.655	8471.	9.331	6.153	.00637	2140.	1000.	5000.	7.827	1884.
55	46	11.678	2.182	7701.	-718.	3.019	7715.	-5.326	17.661	.01496	2616.	861.	5000.	7.827	1884.
56	46														
57	46														

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
58	46	11.911	2.252	7720.	-666.	3.029	7748.	-4.927	17.411	.01479	2608.	865.	5000.	9.735	2103.
59	46	12.152	2.314	7736.	-616.	3.038	7761.	-4.553	17.175	.01463	2600.	868.	5000.	9.679	2332.
60	46	12.294	2.350	7676.	-743.	3.001	7712.	-5.528	18.463	.01554	2632.	870.	5002.	10.241	2469.
61	46	13.034	2.545	7768.	-493.	3.054	7784.	-3.631	16.777	.01436	2588.	874.	5003.	13.496	3254.
62	46	13.368	2.639	7801.	-397.	3.075	7811.	-2.916	16.138	.01391	2571.	876.	5002.	14.929	3603.
63	46	13.723	2.743	7835.	-298.	3.098	7841.	-2.181	15.466	.01343	2552.	877.	5002.	16.461	3976.
64	46	14.054	2.844	7864.	-214.	3.119	7867.	-1.560	14.897	.01302	2535.	878.	5001.	17.888	4325.
65	46	14.378	2.945	7889.	-138.	3.138	7890.	-1.003	14.381	.01264	2520.	878.	5001.	19.289	4667.
66	46	14.704	3.049	7912.	-68.	3.156	7912.	-.490	13.904	.01230	2505.	879.	5000.	20.707	5014.
67	46	15.048	3.162	7934.	0.	3.174	7934.	0.000	13.444	.01196	2491.	879.	4999.	22.213	5392.

67 F = 4850.0 FID = 4947.2 ETAF = .9824 ISP = 242.166 ISPID = 244.042 ETAI = .9923

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
43	47	6.872	0.000	7725.	0.	3.011	7725.	0.000	20.803	.01758	2622.	1000.	5000.	0.000	0.
44	47	7.131	.092	7781.	81.	3.053	7781.	.595	19.209	.01645	2588.	1000.	5000.	.023	6.
45	47	7.487	.221	7852.	189.	3.110	7854.	1.389	17.267	.01505	2542.	1000.	5000.	.124	31.
46	47	8.019	.420	7949.	347.	3.191	7956.	2.498	14.804	.01324	2478.	1000.	5000.	.399	99.
47	47	8.822	.731	8075.	574.	3.307	8096.	4.063	11.878	.01102	2388.	1000.	5000.	1.027	253.
48	47	9.532	1.019	8170.	757.	3.402	8205.	5.292	9.918	.00948	2318.	1000.	5000.	1.745	425.
49	47	10.205	1.301	8246.	918.	3.487	8297.	6.351	8.452	.00830	2257.	1000.	5000.	2.524	616.
50	47	10.853	1.580	8310.	1061.	3.553	8378.	7.275	7.319	.00736	2203.	1000.	5000.	3.340	809.
51	47	11.484	1.858	8365.	1189.	3.633	8449.	8.092	6.419	.00660	2156.	1000.	5000.	4.180	1002.
52	47	12.106	2.139	8412.	1307.	3.697	8513.	8.829	5.686	.00596	2112.	1000.	5000.	5.041	1196.
53	47														
54	47														
55	47	11.996	2.089	8404.	1285.	3.686	8501.	8.693	5.810	.00607	2120.	1000.	5000.	6.098	1474.
55	47	11.996	2.089	7718.	-819.	3.039	7762.	-6.057	16.903	.01441	2599.	856.	5000.	6.098	1474.
56	47														
57	47														
58	47	12.174	2.131	7732.	-778.	3.046	7771.	-5.744	16.739	.01430	2593.	860.	5000.	6.722	1625.
59	47	12.426	2.192	7750.	-724.	3.055	7784.	-5.338	16.527	.01416	2586.	864.	5000.	7.615	1841.
60	47	12.561	2.224	7687.	-852.	3.017	7734.	-6.324	17.805	.01507	2618.	866.	5002.	8.103	1960.
61	47	13.338	2.416	7784.	-588.	3.071	7806.	-4.321	16.198	.01394	2575.	872.	5003.	11.233	2714.
62	47	13.687	2.509	7819.	-487.	3.092	7834.	-3.567	15.584	.01350	2557.	874.	5002.	12.607	3048.
63	47	14.058	2.613	7854.	-383.	3.116	7864.	-2.795	14.937	.01304	2538.	875.	5002.	14.079	3407.
64	47	14.403	2.713	7884.	-295.	3.136	7889.	-2.144	14.386	.01264	2521.	876.	5002.	15.450	3741.
65	47	14.741	2.814	7910.	-216.	3.155	7913.	-1.561	13.887	.01228	2505.	877.	5001.	16.796	4070.
66	47	15.080	2.919	7934.	-142.	3.174	7936.	-1.025	13.424	.01194	2491.	878.	5001.	18.158	4403.
67	47	15.437	3.032	7957.	-71.	3.192	7958.	-.514	12.978	.01161	2477.	879.	5000.	19.605	4757.
68	47	15.841	3.162	7981.	0.	3.211	7981.	0.000	12.525	.01127	2461.	879.	4999.	21.257	5160.

68 F = 4860.0 FID = 4947.2 ETAF = .9824 ISP = 242.166 ISPID = 244.042 ETAI = .9923

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
44	48	7.404	0.000	7837.	0.	3.096	7837.	0.000	17.705	.01537	2553.	1000.	5000.	0.000	0.
45	48	7.778	.129	7909.	108.	3.153	7910.	.785	15.894	.01404	2507.	1000.	5000.	.039	10.
46	48	8.338	.329	8007.	266.	3.236	8011.	1.904	13.596	.01233	2443.	1000.	5000.	.227	56.
47	48	9.184	.643	8135.	493.	3.353	8150.	3.468	10.873	.01024	2353.	1000.	5000.	.737	181.
48	48	9.934	.933	8230.	676.	3.450	8258.	4.695	9.058	.00879	2283.	1000.	5000.	1.360	333.
49	48	10.646	1.219	8308.	837.	3.536	8350.	5.752	7.703	.00768	2222.	1000.	5000.	2.058	500.
50	48	11.331	1.502	8372.	980.	3.613	8429.	6.675	6.658	.00680	2169.	1000.	5000.	2.801	674.
51	48	11.998	1.786	8427.	1103.	3.684	8500.	7.490	5.831	.00609	2121.	1000.	5000.	3.574	851.
52	48														
53	48														
54	48														
55	48	12.393	1.956	8456.	1177.	3.723	8538.	7.925	5.418	.00573	2095.	1000.	5000.	5.279	1271.
55	48	12.393	1.956	7734.	-946.	3.062	7792.	-6.973	16.056	.01378	2581.	849.	5000.	5.279	1271.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	HDOT	F
56	48														
57	48														
58	48	12.496	1.979	7743.	-921.	3.066	7797.	-6.783	15.980	.01373	2578.	831.	5000.	5.596	1368.
59	48	12.760	2.037	7762.	-861.	3.075	7809.	-6.330	15.801	.01362	2570.	857.	5000.	5.428	1549.
60	48	12.886	2.064	7695.	-990.	3.036	7758.	-7.331	17.071	.01453	2603.	859.	5001.	6.833	1647.
61	48	13.711	2.252	7798.	-706.	3.089	7830.	-5.173	15.566	.01347	2560.	867.	5003.	9.807	2362.
62	48	14.079	2.344	7835.	-598.	3.111	7858.	-4.364	14.984	.01306	2542.	870.	5002.	11.110	2679.
63	48	14.472	2.447	7873.	-487.	3.135	7888.	-3.538	14.365	.01261	2523.	873.	5002.	12.508	3019.
64	48	14.835	2.547	7904.	-393.	3.156	7914.	-2.845	13.835	.01223	2505.	874.	5002.	13.918	3337.
65	48	15.190	2.648	7932.	-308.	3.175	7938.	-2.225	13.355	.01188	2491.	876.	5002.	15.089	3650.
66	48	15.546	2.752	7957.	-230.	3.194	7961.	-1.657	12.908	.01155	2476.	877.	5001.	16.395	3966.
67	48	15.919	2.865	7981.	-155.	3.212	7983.	-1.116	12.476	.01123	2461.	877.	5001.	17.759	4302.
68	48	16.341	2.996	8005.	-80.	3.231	8006.	-.573	12.039	.01090	2446.	878.	5000.	19.327	4685.
69	48	16.865	3.162	8031.	0.	3.253	8031.	0.000	11.569	.01055	2429.	879.	4999.	21.305	5168.
69		F =	4860.0	F1D =		4947.2	ETAF = .9824		ISP =	242.166		ISP1D =	244.042	ETAI =	.9923
45	49	8.178	0.000	7982.	0.	3.212	7982.	0.000	14.223	.01280	2461.	1000.	5000.	0.000	0.
46	49	8.777	.200	8001.	158.	3.296	8083.	1.119	12.123	.01121	2397.	1000.	5000.	.075	18.
47	49	9.685	.517	8211.	385.	3.416	8220.	2.683	9.659	.00927	2307.	1000.	5000.	.429	105.
48	49	10.490	.811	8308.	567.	3.514	8327.	3.905	8.022	.00794	2237.	1000.	5000.	.929	226.
49	49	11.255	1.102	8386.	728.	3.602	8418.	4.960	6.804	.00693	2177.	1000.	5000.	1.519	367.
50	49	11.992	1.390	8452.	871.	3.681	8496.	5.881	5.868	.00612	2123.	1000.	5000.	2.166	517.
51	49	12.711	1.679	8507.	999.	3.752	8566.	6.694	5.129	.00547	2076.	1000.	5000.	2.851	672.
52	49														
53	49														
54	49														
55	49	12.930	1.768	8523.	1034.	3.773	8585.	6.915	4.936	.00530	2063.	1000.	5000.	5.355	1286.
55	49	12.930	1.768	7745.	-1124.	3.088	7826.	-8.257	17.071	.01304	2560.	7.	5000.	5.355	1286.
56	49														
57	49														
58	49														
59	49	13.204	1.821	7766.	-1054.	3.097	7838.	-7.730	14.942	.01297	2552.	844.	5000.	6.083	1462.
60	49	13.317	1.842	7694.	-1185.	3.056	7785.	-8.754	16.207	.01388	2586.	847.	5001.	6.391	1537.
61	49	14.212	2.023	7807.	-866.	3.109	7855.	-6.330	14.858	.01294	2544.	860.	5002.	9.153	2199.
62	49	14.609	2.113	7848.	-745.	3.131	7883.	-5.426	14.321	.01256	2526.	864.	5002.	10.360	2491.
63	49	15.031	2.215	7889.	-623.	3.155	7914.	-4.512	13.759	.01214	2507.	868.	5002.	11.659	2807.
64	49	15.420	2.314	7923.	-519.	3.177	7940.	-3.748	13.237	.01178	2490.	870.	5002.	12.870	3103.
65	49	15.799	2.415	7953.	-426.	3.196	7965.	-3.068	12.777	.01144	2474.	872.	5002.	14.059	3393.
66	49	16.178	2.519	7980.	-341.	3.215	7988.	-2.448	12.348	.01112	2459.	874.	5002.	15.264	3687.
67	49	16.575	2.632	8006.	-260.	3.234	8010.	-1.859	11.933	.01081	2444.	875.	5001.	16.544	4000.
68	49	17.021	2.764	8032.	-178.	3.254	8034.	-1.272	11.511	.01050	2429.	876.	5001.	18.007	4358.
69	49	17.570	2.930	8059.	-92.	3.276	8059.	-.654	11.058	.01016	2412.	878.	5000.	19.848	4807.
70	49	18.312	3.162	8088.	0.	3.301	8088.	0.000	10.567	.00978	2393.	879.	4999.	22.416	5433.
70		F =	4860.0	F1D =		4947.2	ETAF = .9824		ISP =	242.166		ISP1D =	244.042	ETAI =	.9923
46	50	9.437	0.000	8184.	0.	3.383	8184.	0.000	10.272	.00976	2331.	1000.	5000.	0.000	0.
47	50	10.439	.320	8[illegible]6.	227.	3.507	8319.	1.564	8.135	.00804	2242.	1000.	5000.	.136	33.
48	50	11.330	.618	8414.	408.	3.607	8423.	2.778	6.731	.00686	2173.	1000.	5000.	.462	111.
49	50	12.179	.913	8494.	569.	3.697	8513.	3.832	5.688	.00597	2113.	1000.	5000.	.901	215.
50	50	12.997	1.208	8560.	711.	3.778	8590.	4.751	4.890	.00526	2060.	1000.	5000.	1.413	332.
51	50	13.796	1.505	8617.	839.	3.852	8658.	5.563	4.262	.00469	2013.	1000.	5000.	1.975	456.
52	50														
53	50														
54	50														

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
55	50	13.713	1.473	8610.	821.	3.842	8649.	5.447	4.335	.00476	2019.	1000.	5000.	3.680	888.
55	50	13.713	1.473	7736.	-1399.	3.116	7862.	-10.252	13.933	.01217	2537.	816.	5000.	3.680	888.
56	50														
57	50														
58	50														
59	50	13.833	1.491	7747.	-1368.	3.119	7866.	-9.975	13.922	.01217	2535.	821.	5000.	3.924	946.
60	50	13.927	1.595	7665.	-1495.	3.075	7810.	-11.039	15.197	.01310	2571.	824.	5001.	4.118	993.
61	50	14.937	1.670	7797.	-1100.	3.125	7874.	-8.033	14.159	.01239	2531.	844.	5002.	6.566	1576.
62	50	15.380	1.757	7845.	-953.	3.146	7902.	-6.929	13.698	.01207	2513.	851.	5002.	7.632	1834.
63	50	15.848	1.858	7892.	-806.	3.171	7933.	-5.832	13.171	.01170	2494.	857.	5002.	8.787	2114.
64	50	16.278	1.955	7931.	-684.	3.193	7960.	-4.926	12.702	.01136	2477.	861.	5002.	9.866	2377.
65	50	16.693	2.057	7965.	-575.	3.213	7985.	-4.130	12.266	.01104	2461.	865.	5002.	10.930	2636.
66	50	17.107	2.163	7995.	-477.	3.233	8009.	-3.411	11.352	.01074	2446.	867.	5002.	12.009	2899.
67	50	17.537	2.277	8024.	-383.	3.253	8033.	-2.736	11.449	.01044	2430.	870.	5002.	13.157	3180.
68	50	18.018	2.410	8052.	-291.	3.273	8057.	-2.068	11.036	.01013	2414.	872.	5001.	14.472	3501.
69	50	18.606	2.579	8082.	-193.	3.296	8084.	-1.371	10.592	.00979	2397.	874.	5001.	16.129	3905.
70	50	19.393	2.813	8113.	-91.	3.322	8114.	-.641	10.112	.00943	2377.	876.	5000.	18.438	4468.
71	50	18.664	3.047	8096.	-30.	3.308	8096.	-.209	10.419	.00967	2388.	878.	5000.	18.438	4468.
71	50	19.025	3.162	8106.	0.	3.316	8106.	0.000	10.265	.00955	2381.	879.	4999.	19.683	4772.

71 F = 4869.0 FID = 4947.2 ETAF = .9824 ISP = 242.166 ISPID = 244.042 ETAI = .9923

PROPERTIES ALONG THE NOZZLE WALL CONTOUR.

I	X	Y	P	F(1-D)	F(2-D)	ETA(F)	ISP(1-D)	ISP(2-D)	ETA(I)
11	0.00000	1.00000	444.242	3855.	3832.	.9940	190.176	190.942	1.0040
12	.00017	1.00000	424.910	3809.	3832.	1.0060	187.898	190.942	1.0162
13	.00035	1.00001	406.852	3809.	3832.	1.0060	187.899	190.943	1.0162
14	.00052	1.00001	389.830	3809.	3832.	1.0060	187.900	190.943	1.0162
15	.00070	1.00002	373.685	3809.	3832.	1.0060	187.902	190.945	1.0162
16	.00087	1.00004	358.305	3809.	3832.	1.0060	187.904	190.946	1.0162
17	.00105	1.00005	343.606	3809.	3832.	1.0060	187.907	190.948	1.0162
18	.00122	1.00007	329.525	3809.	3832.	1.0060	187.911	190.950	1.0162
19	.00139	1.00010	316.011	3809.	3832.	1.0060	187.914	190.952	1.0162
20	.00156	1.00012	303.024	3809.	3832.	1.0060	187.919	190.955	1.0162
21	.00174	1.00015	290.529	3810.	3832.	1.0060	187.923	190.957	1.0161
22	.00191	1.00018	278.499	3810.	3832.	1.0060	187.929	190.960	1.0161
23	.00208	1.00022	266.909	3810.	3832.	1.0060	187.934	190.963	1.0161
24	.00225	1.00026	255.739	3810.	3832.	1.0059	187.940	190.965	1.0161
25	.00242	1.00030	244.969	3810.	3833.	1.0059	187.947	190.968	1.0161
26	.00259	1.00034	234.583	3810.	3833.	1.0059	187.954	190.972	1.0161
27	.15256	1.04053	236.064	3919.	3889.	.9925	193.310	195.804	1.0026
28	.25176	1.07782	233.036	4001.	3944.	.9858	197.365	196.523	.9957
29	.42175	1.11266	226.856	4068.	3996.	.9821	200.688	199.093	.9921
30	.54538	1.14578	218.612	4126.	4044.	.9802	203.534	201.529	.9901
31	.66437	1.17766	209.133	4177.	4091.	.9794	206.040	203.838	.9893
32	.77974	1.20858	199.031	4222.	4135.	.9793	208.284	206.024	.9892
33	.89202	1.23866	188.755	4263.	4176.	.9795	210.315	208.089	.9894
34	1.00140	1.26797	178.617	4301.	4215.	.9800	212.166	210.031	.9899
35	1.10799	1.29653	168.823	4335.	4252.	.9807	213.861	211.854	.9906
36	1.21195	1.32439	159.490	4367.	4286.	.9815	215.421	213.562	.9914
37	1.31227	1.35127	150.793	4396.	4318.	.9822	216.846	215.142	.9921
38	1.41220	1.37805	142.464	4423.	4348.	.9830	218.194	216.651	.9929
39	1.51136	1.40461	134.581	4449.	4377.	.9838	219.465	218.084	.9937
40	1.61123	1.43137	127.047	4474.	4404.	.9845	220.684	219.463	.9945
41	1.71427	1.45899	119.707	4498.	4432.	.9853	221.882	220.820	.9952
42	1.82531	1.48874	112.289	4523.	4460.	.9860	223.109	222.211	.9960
43	1.95376	1.52316	104.325	4550.	4490.	.9868	224.452	223.729	.9968
44	2.11710	1.56692	95.102	4582.	4526.	.9877	226.049	225.527	.9977
45	2.34641	1.62837	83.710	4624.	4572.	.9888	228.105	227.820	.9988
46	2.70042	1.72322	69.143	4681.	4634.	.9899	230.901	230.882	.9999
47	3.26681	1.87499	51.830	4755.	4712.	.9908	234.582	234.765	1.0008
48	3.81419	2.02166	40.275	4812.	4767.	.9907	237.386	237.551	1.0007
49	4.37731	2.17254	31.829	4858.	4810.	.9900	239.642	239.651	1.0000
50	4.96412	2.32978	25.502	4894.	4840.	.9890	241.429	241.187	.9990
51	5.58177	2.49528	20.663	4922.	4861.	.9877	242.782	242.225	.9977
52	6.23499	2.67031	16.893	4940.	4873.	.9863	243.707	242.794	.9963
53	6.91778	2.85326	13.997	4950.	4875.	.9848	244.191	242.905	.9947
54	7.63905	3.04652	11.678	4951.	4868.	.9833	244.229	242.566	.9932
55	8.07105	3.16228	10.619	4947.	4860.	.9824	244.042	242.166	.9923
55	8.07105	3.16228	28.970	4947.	4860.	.9824	244.042	242.166	.9923
56	8.76419	3.16228	25.646	4947.	4860.	.9824	244.042	242.166	.9923
57	9.25639	3.16228	23.807	4947.	4860.	.9824	244.042	242.166	.9923
58	9.61793	3.16228	23.162	4947.	4860.	.9824	244.042	242.166	.9923
59	9.99188	3.16228	22.443	4947.	4860.	.9824	244.042	242.166	.9923
60	10.35857	3.16228	25.201	4947.	4860.	.9824	244.042	242.166	.9923
61	11.44929	3.16228	20.844	4947.	4860.	.9824	244.042	242.166	.9923
62	11.98568	3.16228	19.299	4947.	4860.	.9824	244.042	242.166	.9923
63	12.58121	3.16228	17.751	4947.	4860.	.9824	244.042	242.166	.9923

I	X	Y	P	F(1-D)	F(2-D)	ETA(F)	ISP(1-D)	ISP(2-D)	ETA(I)
64	13.16189	3.16228	16.483	4947.	4860.	.9824	244.042	242.166	.9923
65	13.75321	3.16228	15.315	4947.	4860.	.9824	244.042	242.166	.9923
66	14.37160	3.16228	14.377	4947.	4860.	.9824	244.042	242.166	.9923
67	15.04764	3.16228	13.444	4947.	4860.	.9824	244.042	242.166	.9923
68	15.84054	3.16228	12.525	4947.	4860.	.9824	244.042	242.166	.9923
69	16.86258	3.16228	11.569	4947.	4860.	.9824	244.042	242.166	.9923
70	18.31153	3.16228	10.567	4947.	4860.	.9824	244.042	242.166	.9923
71	19.02550	3.16228	10.265	4947.	4860.	.9824	244.042	242.166	.9923

PERFORMANCE OF THE SCARFED EXTENSION

I	X	Y	P	PSI	DFX	ISPX	DFY	ISPY	ISP
55	8.071	3.162	28.970	0.000	0.	242.166	0.	0.000	242.166
56	8.764	3.162	25.646	29.138	0.	242.166	-.1391E+02	.693	242.165
57	9.256	3.162	23.807	38.410	0.	242.166	-.173[illegible]E+02	1.558	242.166
58	9.618	3.162	23.162	44.145	0.	242.166	-.1526E+02	2.218	242.166
59	9.992	3.162	22.443	49.511	0.	242.166	-.1398E+02	2.915	242.166
60	9.992	3.162	22.443	49.511	0.	242.166	0.	2.915	242.166
61	9.992	3.162	22.443	49.511	0.	242.166	0.	2.915	242.166
62	9.992	3.162	22.443	49.511	0.	242.166	0.	2.915	242.166
63	10.359	3.162	25.201	54.383	0.	242.166	-.1667E+02	3.746	242.166
64	10.359	3.162	25.201	54.383	0.	242.166	0.	3.746	242.166
65	11.449	3.162	20.844	67.467	0.	242.166	-.5020E+02	6.247	242.166
66	11.986	3.162	19.299	73.424	0.	242.166	-.[illegible]718E+02	7.103	242.166
67	12.581	3.162	17.751	79.831	0.	242.166	-.1063E+02	7.802	242.166
68	13.162	3.162	16.483	85.955	0.	242.166	-.8323E+01	8.242	242.166
69	13.753	3.162	15.375	92.140	0.	242.166	-.6611E+01	8.472	242.166
70	14.372	3.162	14.37[illegible]	98.645	0.	242.166	-.7084E+00	8.507	242.166
71	15.048	3.162	13.449	105.887	0.	242.166	.3281E+01	8.343	242.166
72	15.841	3.162	12.523	114.741	0.	242.166	.8[illegible]E+01	7.962	242.166
73	16.863	3.162	11.569	127.236	0.	242.166	.1468E+02	7.211	242.166
74	18.312	3.162	10.537	150.418	0.	242.166	.2189E+02	6.120	242.166
75	19.025	3.162	10.265	180.000	0.	242.166	.4934E+01	5.874	242.166

SUMMARY OF OVERALL SCARFED NOZZLE PERFORMANCE PARAMETERS

```
MDOT   =    .200691E+02 LBM/SEC
FXN    =   -.486005E+04 LBF    ISPXN    =  242.166 (LBF-SEC)/LBM
FYN    =   -.117889E+03 LBF    ISPYN    =    5.374 (LBF-SEC)/LBM
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SUMMARY OF OVERALL MISSILE PERFORMANCE PARAMETERS

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FXM    =   -.414998E+04 LBF    ISPXM    =  206.785 (LBF-SEC)/LBM
FYM    =   -.253212E+04 LBF    ISPYM    =  126.176 (LBF-SEC)/LBM
ETA    =    .8539              BETAEFF  =   31.362 DEG
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APPENDIX B

ABBREVIATED OUTPUT FOR SAMPLE CASE NO. 1

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NOZZLE PERFORMANCE PREDICTION PROGRAM.

THIS PROGRAM WILL ANALYZE THE FLOWFIELD AND PERFORMANCE OF PROPULSIVE NOZZLES FOR SEVERAL OPTIONS.

  MODE 1. IRROTATIONAL FLOW ALONG RIGHT-RUNNING CHARACTERISTICS.

  MODE 2. IRROTATIONAL FLOW ALONG LEFT-RUNNING CHARACTERISTICS.

  MODE 3. FLOW WITH AN EMBEDDED RIGHT-RUNNING OBLIQUE SHOCK WAVE.

  MODE 4. FLOW IN A SCARFED NOZZLE EXTENSION.

THE PROGRAM WILL ANALYZE THE PERFORMANCE OF A COMPRESSED PROPULSIVE NOZZLE. ICMP = 1.

THE PROGRAM CAN DETECT AND TRACK AN EMBEDDED RIGHT-RUNNING OBLIQUE SHOCK WAVE (MODE = 3 OR 5).  THE FLOWFIELD AHEAD OF
THE SHOCK WAVE IS ASSUMED TO BE IRROTATIONAL. AND THE FLOWFIELD DOWNSTREAM OF THE SHOCK WAVE IS ASSUMED TO BE ROTATIONAL.

THIS PROGRAM WAS WRITTEN BY JOE D. HOFFMAN. SCHOOL OF MECHANICAL ENGINEERING. PURDUE UNIVERSITY. WEST LAFAYETTE IN 47907.
TELEPHONE NUMBER 317-494-1506.


JOB TITLE -

  SAMPLE CASE NO. 1.  NOMINAL CASE WITH AA=15.0. EPS=10.0. AF=0.0. AND BETA=30.0


PROBLEM SPECIFICATIONS -

  ANALYSIS OF A SCARFED NOZZLE WITH AN ATTACHED RIGHT-RUNNING OBLIQUE SHOCK WAVE.

  THE ANALYSIS IS PERFORMED IN EE UNITS (LBF. LBM. IN.. FT/SEC. R).

  THERE ARE 11 POINTS ALONG THE INITIAL-VALUE LINE. AND 15 POINTS ALONG THE CIRCULAR ARC THROAT CONTOUR.

  THE OUTPUT FLAGS ARE IWRITE =   0. JWRITE =   0. AND KWRITE = 1.

  THE GRID SPACING CONTROL PARAMETERS ARE DYRATIO = 1.000 AND DARATIO = 1.000.

  THE ACCURACY CONTROL PARAMETERS ARE ICORT =  2.  E1 =  0.       . AND E2 =  0.      .


THERMODYNAMIC MODEL -

  G = 1.200.  RG = 65.000 (FT-LBF)/(LBM-R).  PS =  1000. LBF/IN.**2.  TS =  5000. R.  AND  PA =  15. LBF/IN.**2.
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NOZZLE GEOMETRIC SPECIFICATIONS -

   THE NOZZLE CROSS-SECTION IS AXISYMMETRIC.

   THE NOZZLE THROAT GEOMETRY IS SPECIFIED BY YT =  1.000 IN.,  RTU =  1.000 IN., AND RTD =   .010 IN.

   THE NOZZLE CONTOUR IS CONICAL, AA =  15.000 DEG, YE =    3.162 IN., AND EPS =  10.000.

   THE NOZZLE LENGTH XE =    8.071 IN. AND THE EXIT RADIUS YE =    3.162 IN.

   THE CHARACTERISTIC GRID IS STOPPED AT XMAX = 1000.000 IN.
 GEOMETRIC SPECIFICATION OF THE SCARFED EXTENSION.

   XE =    8.071 IN. AND YE =    3.162 IN.

   XF =   19.025 IN., YF =    3.162 IN., AND AF =  0.000 DEG.

   THE SCARF ANGLE BETA = 30.000 DEG.

$DATA

IUNITS  = 1,

MODE    = 4,

IWALL   = 1,

JWALL   = 0,

NI      = 11,

NT      = 15,

IVS     = 1,

IOUT    = 1,

IWRITE  = 0,

JWRITE  = 0,

KWRITE  = 1,

LWRITE  = 0,

MWRITE  = 0,

NWRITE  = 0,

G       = .12E+01,

RG      = .65E+02,

PS      = .1E+04,

TS      = .5E+04,

PA      = .14696E+02,

DELTA   = .1E+01,

YT      = .1E+01,
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RTU      = .1E+01,
RTD      = .1E-01,
AA       = .15E+02,
AC       = .15E+02,
EPS      = .1E+02,
YC       = .31622776601684E+01,
XC       = .60710406127984E+01,
XMAX     = .1E+04,
XF       = 0.0,
YF       = .19025497762899E+02,
BETA     = .3E+02,
CYRATIO  = .1E+01,
DARATIO  = .1E+01,
ICOR1    = 2.,
ICORR    = 3.,
E1       = 0.0,
E2       = 0.0,
IDUMP    = 0. 0. 0. 0. 0. 0. 0. 0. 0. 2.,
ICMP     = 0.,
IPLOT    = 0.,
ICPLOT   = 3.,
YMAX     = .75E+02,
XDES     = 0.0,
YDES     = 0.0,
IE       = 0.,
JE       = 0.,
$END
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INITIAL-VALUE LINE SPECIFICATIONS.

INITIAL-VALUE LINE CALCULATED BY THE KLIEGEL-LEVINE METHOD.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
1	11	.262	0.000	3471.	0.	1.031	3471.	0.00	545.67	.26746	4520.	1000.	5000.	0.000	0.
2	10	.260	.100	3475.	7.	1.032	3475.	.11	545.00	.26719	4519.	1000.	5000.	.203	39.
3	9	.252	.200	3485.	13.	1.035	3485.	.21	542.49	.26636	4516.	1000.	5000.	.810	154.
4	8	.238	.300	3502.	19.	1.041	3502.	.30	539.56	.26496	4511.	1000.	5000.	1.823	347.
5	7	.220	.400	3527.	23.	1.049	3527.	.37	534.58	.26292	4504.	1000.	5000.	3.241	617.
6	6	.197	.500	3560.	25.	1.060	3561.	.41	527.19	.26013	4495.	1000.	5000.	5.063	963.
7	5	.168	.600	3605.	25.	1.075	3606.	.40	518.81	.25644	4482.	1000.	5000.	7.288	1387.
8	4	.134	.700	3665.	22.	1.095	3665.	.35	507.02	.25157	4465.	1000.	5000.	9.912	1887.
9	3	.094	.800	3743.	17.	1.121	3743.	.26	491.59	.24516	4442.	1000.	5000.	12.928	2462.
10	2	.050	.900	3846.	9.	1.156	3846.	.13	471.15	.23665	4411.	1000.	5000.	16.321	3112.
11	1	0.000	1.000	3984.	-0.	1.203	3984.	-.00	444.24	.22534	4368.	1000.	5000.	20.069	3832.

INITIAL-VALUE LINE PERFORMANCE PARAMETERS.

MDOT = 20.069 LBM/SEC. MDOT(1-D) = 20.272 LBM/SEC. CC = .9900

F = 3832. LBF. F(1-D) = 3855. LBF. ETAF = .9940

ISP = 190.942 LBF-SEC/LBM. ISP(1-D) = 190.176 LBF-SEC/LBM. ETAI = 1.0040

IRROTATIONAL FLOWFIELD ALONG RIGHT-RUNNING CHARACTERISTICS EMANATING FROM THE INITIAL-VALUE LINE.

I	J	X	Y	U	V	R	VMAG	THETA	P	RHO	T	PT	TT	WDOT	F
1	11	.262	0.000	3471.	0.	1.031	3471.	0.000	545.665	.26745	4520.	1000.	5000.	0.000	0.
2	10	.262	.180	3475.	7.	1.032	3475.	.110	545.005	.26719	4519.	1000.	5000.	.203	35.
2	12	.284	0.000	3525.	0.	1.048	3525.	0.000	534.839	.26583	4505.	1000.	5000.	-.000	-0.
3	9	.252	.288	3485.	13.	1.035	3485.	.214	542.941	.26636	4516.	1000.	5000.	.610	154.
3	13	.316	0.000	3589.	0.	1.075	3589.	0.000	552.075	.25778	4467.	1000.	5000.	-.000	-0.
4	8	.239	.368	3502.	19.	1.041	3502.	.303	539.503	.26496	4511.	1000.	5000.	1.823	347.
4	14	.344	0.000	3656.	0.	1.092	3656.	0.000	508.627	.25226	4467.	1000.	5000.	-.000	-0.
5	7	.224	.460	3527.	23.	1.049	3527.	.371	534.597	.26292	4504.	1000.	5000.	3.241	617.
5	15	.374	0.000	3726.	0.	1.116	3726.	0.000	494.709	.24649	4447.	1000.	5000.	-.000	-0.
6	6	.197	.545	3560.	25.	1.058	3561.	.406	527.790	.26013	4495.	1000.	5000.	5.063	963.
6	16	.405	0.000	3800.	0.	1.148	3800.	0.000	480.224	.24044	4425.	1000.	5000.	-.000	-0.
7	5	.168	.636	3605.	25.	1.075	3606.	.402	518.601	.25644	4482.	1000.	5000.	7.288	1387.
7	17	.438	0.000	3875.	0.	1.167	3875.	0.000	464.615	.23391	4400.	1000.	5000.	-.000	-0.
8	4	.134	.708	3665.	22.	1.095	3665.	.351	507.020	.25193	4465.	1000.	5000.	9.912	1887.
8	18	.478	0.000	3971.	0.	1.199	3971.	0.000	446.619	.22642	4372.	1000.	5000.	-.001	-0.
9	3	.094	.848	3743.	17.	1.121	3743.	.256	491.543	.24516	4442.	1000.	5000.	12.928	2462.
9	19	.528	0.000	4084.	0.	1.234	4084.	0.000	424.917	.21738	4335.	1000.	5000.	-.001	-0.
10	2	.050	.900	3846.	9.	1.156	3846.	.128	471.151	.23665	4411.	1000.	5000.	16.321	3112.
10	20	.590	0.000	4236.	0.	1.292	4236.	0.000	396.090	.20479	4285.	1000.	5000.	-.002	-0.
11	1	0.000	1.000	3984.	-0.	1.203	3984.	-.000	444.242	.22534	4368.	1000.	5000.	20.069	3832.
11	21	.781	0.000	4450.	0.	1.369	4450.	0.000	354.905	.18776	4211.	1000.	5000.	-.003	-0.

IRROTATIONAL FLOWFIELD ALONG RIGHT-RUNNING CHARACTERISTICS EMANATING FROM THE INITIAL EXPANSION CONTOUR.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
12	1	.880	1.000	4584.	-21.	1.238	4084.	1.000	424.910	.21713	4335.	1000.	5000.	20.069	3832.
12	22	.857	0.000	4142.	0.	1.516	4842.	0.000	289.035	.15750	4066.	1000.	5000.	-.005	-1.
13	1	.880	1.000	4177.	146.	1.272	4179.	2.000	406.852	.20942	4304.	1000.	5000.	20.069	3832.
13	23	.993	0.000	5142.	0.	1.647	5142.	0.000	238.791	.13433	3938.	1000.	5000.	-.006	-1.
14	1	.881	1.000	4264.	223.	1.334	4270.	3.000	389.830	.20209	4273.	1000.	5000.	20.069	3832.
14	24	1.1.7	0.000	5457.	0.	1.764	5457.	0.000	196.875	.11437	3814.	1000.	5000.	-.007	-1.
15	1	.8..	1.001	4347.	304.	1.348	4357.	4.000	373.685	.19509	4243.	1000.	5000.	20.069	3832.
15	25	1.269	0.000	5728.	0.	1.882	5728.	0.000	162.270	.09735	3693.	1000.	5000.	-.008	-1.
16	1	.101	1.300	4425.	387.	1.366	4442.	5.000	358.305	.18857	4214.	1900.	5000.	20.069	3832.
16	26	1.417	0.000	5962.	0.	1.997	5962.	0.000	133.381	.08268	3574.	1000.	5000.	-.009	-1.
17	1	.901	1.033	4499.	473.	1.396	4526.	6.000	343.606	.18191	4185.	1000.	5000.	20.069	3832.
17	27	1.744	0.000	6223.	0.	2.112	6223.	0.002	109.248	.07001	3457.	1000.	5000.	-.010	-1.
18	1	.921	1.005	4569.	561.	1.426	4604.	7.000	329.525	.17568	4155.	1000.	5000.	20.069	3832.
18	28	1.723	0.000	6451.	0.	2.228	6451.	0.000	89.107	.05908	3342.	1000.	5000.	-.011	-2.
19	1	.981	1.000	4636.	652.	1.455	4682.	8.000	316.011	.16965	4127.	1000.	5000.	20.069	3832.
19	29	1.891	0.000	4669.	2.	2.341	6669.	0.000	72.340	.04965	3227.	1000.	5000.	-.011	-2.
20	1	.908	1.004	4706.	744.	1.484	4756.	9.000	303.024	.16382	4098.	1000.	5000.	20.069	3832.
20	30	2.077	0.000	6879.	0.	2.460	6879.	0.000	58.428	.04156	3115.	1000.	5000.	-.012	-2.
21	1	.882	1.000	4749.	839.	1.512	4833.	10.000	290.529	.15817	4069.	1000.	5000.	20.069	3832.
21	31	2.275	0.000	7079.	0.	2.579	7079.	0.000	46.934	.03462	3003.	1000.	5000.	-.013	-2.
22	1	.902	1.000	4817.	936.	1.541	4907.	11.000	278.499	.15270	4041.	1000.	5000.	20.069	3832.
22	32	2.492	0.000	7272.	0.	2.699	7272.	0.000	37.483	.02871	2893.	1000.	5000.	-.014	-2.
23	1	.907	1.000	4871.	1035.	1.569	4979.	12.000	266.909	.14738	4012.	1000.	5001.	20.069	3832.
23	33	2.738	0.000	7459.	0.	2.822	7459.	0.000	29.752	.02368	2783.	1000.	5000.	-.014	-2.
24	1	.892	1.003	4921.	1136.	1.597	5051.	13.000	255.739	.14222	3984.	1000.	5000.	20.069	3832.
24	34	2.993	0.000	7639.	0.	2.948	7639.	0.000	23.463	.01945	2675.	1000.	5000.	-.015	-2.
25	1	.882	1.000	4969.	1239.	1.625	5121.	14.000	244.969	.13722	3955.	1000.	5000.	20.069	3833.
25	35	3.284	0.000	7811.	0.	3.077	7811.	0.000	18.379	.01585	2569.	1000.	5000.	-.016	-3.
26	1	.883	1.039	5011.	1343.	1.655	5190.	15.000	234.583	.13235	3927.	1000.	5000.	20.069	3833.
26	36	3.609	0.000	7979.	0.	3.209	7979.	0.000	14.294	.01286	2463.	1000.	5000.	-.017	-3.

IRROTATIONAL FLOWFIELD ALONG LEFT-RUNNING CHARACTERISTICS EMANATING FROM THE KERNEL RIGHT-RUNNING CHARACTERISTIC.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	ROOT	F
26	1	.003	1.004	5013.	1343.	1.653	5190.	15.000	234.583	.13235	3927.	1000.	5000.	20.069	3833.
26	2	.094	.934	4986.	1428.	1.652	5186.	15.984	235.124	.13260	3928.	1000.	5000.	16.320	3510.
27	2	.153	1.041	5004.	1341.	1.649	5180.	15.000	236.058	.13305	3931.	1000.	5000.	20.069	3869.
26	3	.181	.933	4981.	1497.	1.658	5201.	16.730	233.022	.13162	3922.	1000.	5000.	16.729	3221.
28	3	.292	1.078	5023.	1366.	1.658	5201.	15.000	233.036	.13162	3922.	1000.	5000.	20.069	3934.
26	4	.261	.902	4992.	1552.	1.669	5228.	17.275	229.016	.12973	3911.	1000.	5000.	15.320	2967.
29	4	.422	1.113	5069.	1357.	1.675	5243.	15.000	226.855	.12871	3905.	1000.	5000.	20.069	3996.
26	5	.337	.875	5016.	1597.	1.684	5264.	17.662	223.692	.12721	3896.	1000.	5000.	14.071	2742.
30	5	.545	1.146	5119.	1372.	1.698	5300.	15.000	218.612	.12480	3381.	1000.	5000.	20.068	4044.
26	6	.408	.852	5050.	1634.	1.701	5308.	17.925	217.505	.12427	3877.	1000.	5000.	12.959	2541.
31	6	.664	1.178	5184.	1389.	1.726	5367.	15.000	209.133	.12027	3852.	1000.	5000.	20.068	4091.
26	7	.476	.830	5090.	1663.	1.723	5355.	18.089	210.803	.12107	3857.	1000.	5000.	11.965	2362.
32	7	.780	1.209	5255.	1408.	1.757	5441.	15.000	199.031	.11547	3821.	1000.	5000.	20.068	4134.
26	8	.540	.813	5136.	1686.	1.742	5405.	18.175	203.856	.11774	3836.	1000.	5000.	11.077	2201.
33	8	.892	1.239	5330.	1428.	1.790	5516.	15.000	188.755	.11042	3787.	1000.	5000.	20.067	4176.
26	9	.600	.792	5184.	1704.	1.764	5457.	18.198	196.863	.11435	3814.	1000.	5000.	10.284	2057.
34	9	1.001	1.268	5405.	1448.	1.824	5596.	15.000	178.617	.10546	3752.	1000.	5000.	20.067	4215.
26	10	.658	.776	5234.	1718.	1.786	5508.	18.172	189.969	.11101	3791.	1000.	5000.	9.574	1927.
35	10	1.108	1.297	5481.	1469.	1.858	5674.	15.000	168.823	.10062	3717.	1000.	5000.	20.067	4251.
26	11	.712	.760	5284.	1728.	1.808	5560.	18.107	183.263	.10774	3768.	1000.	5000.	6.937	1811.
36	11	1.212	1.324	5555.	1488.	1.892	5751.	15.000	159.490	.09596	3682.	1000.	5000.	20.066	4285.
26	12	.763	.746	5335.	1735.	1.829	5609.	18.014	176.865	.10461	3746.	1000.	5000.	8.372	1707.
37	12	1.312	1.351	5627.	1508.	1.925	5825.	15.000	150.793	.09158	3648.	1000.	5000.	20.066	4317.
26	13	.812	.733	5385.	1739.	1.851	5659.	17.895	170.655	.10153	3774.	1000.	5000.	7.852	1610.
38	13	1.412	1.378	5698.	1527.	1.959	5899.	15.000	142.464	.08734	3613.	1000.	5000.	20.066	4347.
26	14	.860	.721	5436.	1741.	1.873	5708.	17.756	164.639	.09854	3732.	1000.	5000.	7.376	1521.
39	14	1.511	1.405	5768.	1545.	1.992	5971.	15.000	134.581	.08330	3579.	1000.	5000.	20.066	4376.
26	15	.906	.709	5488.	1741.	1.895	5757.	17.598	158.712	.09560	3679.	1000.	5000.	6.932	1438.
40	15	1.611	1.431	5837.	1564.	2.026	6042.	15.000	127.047	.07939	3545.	1000.	5000.	20.065	4404.
26	16	.953	.697	5549.	1738.	1.917	5807.	17.421	152.939	.09266	3656.	1000.	5000.	6.509	1358.
41	16	1.714	1.459	5906.	1583.	2.060	6115.	15.000	119.707	.07555	3510.	1000.	5000.	20.065	4431.
26	17	1.002	.685	5597.	1734.	1.941	5859.	17.216	146.913	.08961	3632.	1000.	5000.	6.089	1279.
42	17	1.825	1.489	5980.	1602.	2.097	6191.	15.000	112.289	.07153	3473.	1000.	5000.	20.065	4459.
26	18	1.057	.672	5661.	1727.	1.968	5919.	16.966	140.286	.08623	3604.	1000.	5000.	5.646	1194.
43	18	1.954	1.523	6062.	1624.	2.139	6276.	15.000	104.325	.06737	3431.	1000.	5000.	20.065	4489.
26	19	1.124	.656	5741.	1715.	2.002	5992.	16.631	132.384	.08216	3570.	1000.	5000.	5.139	1096.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
44	19	2.117	1.567	6153.	1651.	2.191	6380.	15.000	95.102	.06237	3378.	1000.	5000.	20.064	4525.
26	20	1.214	.634	5849.	1693.	2.008	6089.	16.139	122.292	.07688	3522.	1000.	5000.	4.523	975.
45	20	2.386	1.628	6296.	1687.	2.263	6518.	15.000	87.710	.05608	3307.	1000.	5000.	20.063	4571.
26	21	1.343	.605	6008.	1698.	2.116	6230.	15.339	108.541	.06363	3453.	1000.	5000.	3.748	821.
46	21	2.708	1.723	6486.	1738.	2.368	6715.	15.000	69.143	.04782	3203.	1000.	5000.	20.061	4632.
26	22	1.526	.363	6239.	1598.	2.217	6430.	14.018	90.939	.06003	3352.	1000.	5000.	2.836	635.
47	22	3.267	1.875	6752.	1809.	2.525	6990.	15.000	51.820	.03761	3053.	1000.	5000.	20.056	4708.
26	23	1.686	.727	6431.	1465.	2.304	6596.	12.830	77.740	.05272	3266.	1000.	5000.	2.204	502.
48	23	3.814	2.022	6966.	1867.	2.661	7212.	15.000	46.375	.03042	2927.	1000.	5000.	20.053	4763.
26	24	1.834	.492	6603.	1367.	2.384	6743.	11.694	67.184	.04669	3188.	1000.	5000.	1.723	398.
49	24	4.377	2.173	7153.	1917.	2.785	7405.	15.000	31.829	.02505	2815.	1000.	5000.	20.050	4804.
26	25	1.977	.458	6760.	1266.	2.460	6878.	10.606	58.470	.04158	3115.	1000.	5000.	1.365	315.
50	25	4.964	2.330	7318.	1961.	2.900	7576.	15.000	25.502	.02083	2713.	1000.	5000.	20.049	4835.
26	26	2.116	.425	6906.	1162.	2.533	7003.	9.552	51.124	.03718	3046.	1000.	5000.	1.041	247.
51	26	5.582	2.455	7466.	2001.	3.015	7730.	15.000	20.663	.01748	2619.	1000.	5000.	20.047	4855.
26	27	2.254	.391	7041.	1056.	2.604	7120.	8.525	44.923	.03332	2980.	1000.	5000.	.795	190.
52	27	6.235	2.670	7601.	2037.	3.121	7869.	15.000	16.693	.01478	2533.	1000.	5000.	20.037	4864.
26	28	2.393	.356	7169.	946.	2.673	7231.	7.521	39.391	.02992	2917.	1000.	5000.	.594	144.
53	28	6.918	2.853	7729.	2069.	3.220	7992.	15.000	13.997	.01263	2455.	1000.	5000.	20.035	4866.
26	29	2.532	.319	7289.	835.	2.701	7337.	6.536	34.663	.02690	2855.	1000.	5000.	.430	105.
54	29	7.639	3.047	7830.	2098.	3.316	8105.	15.000	11.673	.01086	2382.	1000.	5000.	20.016	4854.
26	30	2.674	.281	7403.	722.	2.808	7437.	5.567	30.541	.02428	2795.	1000.	5000.	.298	74.
54	30	7.670	3.036	7869.	2062.	3.341	8135.	14.684	11.141	.01044	2363.	1000.	5000.	12.110	2929.
55	30	8.671	3.162	7886.	2113.	3.366	8164.	15.000	10.619	.01004	2344.	1000.	5000.	12.110	2929.

ROTATIONAL FLOWFIELD ALONG LEFT-RUNNING CHARACTERISTICS THAT PASS THROUGH THE OBLIQUE SHOCK WAVE.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
55	30	8.071	3.162	7886.	2113.	3.366	8164.	15.000	10.619	.01804	2344.	1000.	5000.	12.110	2929.
55	30	8.071	3.162	7378.	0.	2.768	7378.	.004	28.970	.02267	2831.	879.	5000.	12.110	2929.
26	31	2.819	.202	7511.	606.	2.875	7536.	4.612	26.520	.02179	2737.	1000.	5000.	.194	49.
55	31	8.488	3.060	7962.	2002.	3.407	8210.	14.116	9.825	.00941	2314.	1000.	5000.	18.935	4585.
55	31	8.488	3.060	7434.	-100.	2.806	7435.	-.773	26.907	.02131	2797.	878.	5000.	18.935	4585.
56	31	8.764	3.162	7474.	0.	2.833	7474.	0.000	25.646	.02048	2774.	879.	5000.	19.724	4777.
26	32	2.968	.198	7614.	468.	2.962	7630.	3.670	23.734	.01962	2680.	1000.	5000.	.114	29.
55	32	8.774	2.987	8008.	1931.	3.432	8237.	13.561	9.380	.00905	2296.	1000.	5000.	19.167	4661.
55	32	8.774	2.987	7469.	-161.	2.830	7471.	-1.234	25.699	.02051	2776.	878.	5000.	19.167	4661.
57	32	9.256	3.162	7531.	0.	2.872	7531.	0.000	23.807	.01925	2740.	879.	5000.	22.808	5542.
26	33	3.120	[illegible]	7712.	369.	3.008	7721.	2.738	20.924	.01766	2625.	1000.	5000.	.054	15.
55	33	8.983	2.933	8024.	1907.	3.441	8248.	13.371	9.209	.00891	2289.	1000.	5000.	17.398	4228.
55	33	8.983	2.933	7484.	-178.	2.841	7487.	-1.360	25.196	.02018	2767.	878.	5000.	17.398	4228.
58	33	9.618	3.162	7552.	0.	2.886	7552.	0.000	23.162	.01881	2727.	879.	5000.	22.006	5345.
26	34	3.278	.105	7805.	248.	3.075	7809.	1.817	18.442	.01590	2570.	1000.	5000.	.014	5.
55	34	9.186	2.878	8044.	1880.	3.453	8260.	13.154	9.015	.00876	2281.	1000.	5000.	16.254	3948.
55	34	9.196	2.878	7501.	-199.	2.853	7504.	-1.521	24.649	.01981	2756.	878.	5000.	16.254	3948.
59	34	9.992	3.162	7575.	0.	2.903	7575.	0.000	22.443	.01833	2713.	879.	5000.	21.816	5297.
26	35	3.440	.056	7894.	125.	3.142	7895.	.904	16.245	.01430	2516.	1000.	5000.	-.009	-1.
53	35	-------------------													
55	35	9.196	2.878	8044.	1880.	3.453	8260.	13.154	9.015	.00876	2281.	1000.	5000.	13.561	3290.
55	35	9.196	2.878	7501.	-199.	2.853	7504.	-1.521	24.649	.01981	2756.	878.	5000.	13.561	3290.
59	35	9.992	3.162	7575.	0.	2.903	7575.	0.000	22.443	.01833	2713.	879.	5000.	21.816	5297.
26	36	3.609	0.000	7979.	0.	3.209	7979.	0.000	14.294	.01286	2463.	1000.	5000.	-.017	-3.
53	36	-------------------													
55	36	9.196	2.878	8044.	1880.	3.453	8260.	13.154	9.015	.00876	2281.	1000.	5000.	13.561	3290.
55	36	9.196	2.878	7501.	-199.	2.853	7504.	-1.521	24.649	.01981	2756.	878.	5000.	13.561	3290.
59	36	9.992	3.162	7575.	0.	2.903	7575.	0.000	22.443	.01833	2713.	879.	5000.	21.816	5297.
33	37	3.859	0.000	5743.	0.	1.888	5743.	0.000	160.410	.09642	3686.	1000.	5000.	0.000	0.
35	37	-------------------													
55	37	9.196	2.878	8044.	1880.	3.453	8260.	13.154	9.015	.00876	2281.	1000.	5000.	13.561	3290.
55	37	9.196	2.878	7501.	-199.	2.853	7504.	-1.521	24.649	.01981	2756.	878.	5000.	13.561	3290.
59	37	9.992	3.162	7575.	0.	2.903	7575.	0.000	22.443	.01833	2713.	879.	5000.	21.816	5297.
34	38	4.160	0.000	7068.	0.	2.572	7068.	0.000	47.551	.03500	3010.	1000.	5000.	0.000	0.
55	38	9.447	2.814	7972.	2010.	3.417	8222.	14.148	9.636	.00926	2306.	1000.	5000.	15.069	3659.
55	38	9.447	2.814	7466.	-59.	2.827	7466.	-.452	26.002	.02073	2779.	883.	5000.	15.069	3659.
60	38	10.359	3.162	7487.	0.	2.842	7487.	0.000	25.201	.02018	2766.	879.	5000.	21.713	5273.
35	39	4.570	0.000	6561.	0.	2.245	6561.	0.000	80.344	.05419	3284.	1000.	5000.	0.000	0.
53	39	---------------------													
55	39	9.447	2.814	7972.	2010.	3.417	8222.	14.148	9.636	.00926	2306.	1000.	5000.	12.548	3043.
55	39	9.447	2.814	7466.	-59.	2.827	7466.	-.452	26.002	.02073	2779.	883.	5000.	12.548	3043.
60	39	10.359	3.162	7487.	0.	2.842	7487.	0.000	25.201	.02018	2766.	879.	5000.	21.713	5273.
36	40	4.669	0.000	7094.	0.	2.590	7094.	0.000	46.153	.03414	2995.	1000.	5000.	0.000	0.
55	40	10.024	2.668	8092.	1831.	3.496	8296.	12.752	8.469	.00831	2257.	1000.	5000.	16.392	3980.
55	40	10.024	2.668	7547.	-238.	2.885	7550.	-1.805	23.176	.01882	2728.	878.	5000.	16.392	3980.
61	40	11.449	3.162	7630.	0.	2.942	7630.	0.000	20.844	.01723	2680.	879.	4999.	25.560	6204.

I	J	X	Y	U	V	W	VMAG	THETA	P	RHO	T	PT	TT	RDOT	F
37	41	4.945	0.000	7165.	0.	2.632	7165.	0.000	42.532	.02390	2954.	1000.	5000.	0.000	0.
55	41	10.295	2.595	8134.	1755.	3.514	8326.	12.171	8.033	.00795	2238.	1000.	5000.	11.886	2891.
55	41	10.295	2.595	7578.	-313.	2.909	7584.	-2.362	22.104	.01808	2708.	876.	5000.	11.886	2891.
62	41	11.986	3.162	7686.	0.	2.983	7686.	0.000	19.299	.01616	2645.	873.	4999.	22.075	5364.
38	42	5.228	0.000	7279.	-0.	2.703	7279.	0.000	37.204	.02853	2889.	1000.	5000.	0.000	0.
55	42	10.582	2.516	8145.	1671.	3.544	8339.	11.534	7.579	.00758	2216.	1000.	5000.	10.728	2606.
55	42	10.582	2.516	7610.	-597.	2.955	7620.	-2.389	20.998	.01732	2686.	874.	5000.	10.728	2606.
63	42	12.481	3.162	7746.	0.	3.027	7746.	0.000	17.751	.01507	2609.	879.	4999.	21.925	5325.
39	43	5.514	0.000	7372.	0.	2.764	7372.	0.000	33.182	.02594	2834.	1000.	5000.	0.000	0.
55	43	10.853	2.439	8235.	1595.	3.573	8388.	10.964	7.188	.00725	2197.	1000.	5000.	9.542	2313.
55	43	10.853	2.439	7637.	-475.	2.958	7652.	-3.561	20.054	.01666	2667.	871.	5000.	9.542	2313.
64	43	13.162	3.162	7797.	0.	3.066	7797.	0.000	16.483	.01417	2577.	879.	4999.	21.619	5247.
40	44	5.805	0.000	7460.	0.	2.825	7460.	0.000	29.714	.02366	2783.	1000.	5000.	0.000	0.
55	44	11.128	2.361	8277.	1522.	3.600	8416.	10.419	6.829	.00695	2178.	1000.	5000.	8.521	2060.
55	44	11.128	2.361	7662.	-552.	2.979	7682.	-4.120	19.196	.01606	2649.	869.	5000.	8.521	2060.
65	44	13.753	3.162	7845.	0.	3.103	7845.	0.000	15.375	.01337	2547.	879.	4999.	21.404	5191.
41	45	6.121	0.000	7544.	0.	2.881	7544.	0.000	26.608	.02158	2732.	1000.	5000.	0.000	0.
55	45	11.389	2.280	8318.	1449.	3.627	8443.	9.885	6.489	.00666	2158.	1000.	5000.	7.596	1830.
55	45	11.389	2.280	7686.	-629.	3.000	7712.	-4.682	18.392	.01548	2631.	866.	5000.	7.596	1830.
66	45	14.372	3.162	7890.	0.	3.136	7890.	0.000	14.377	.01265	2519.	879.	4999.	21.237	5147.
42	46	6.469	0.000	7651.	0.	2.942	7651.	0.000	23.701	.01959	2680.	1000.	5000.	0.000	0.
55	46	11.674	2.192	8359.	1373.	3.655	8471.	9.331	6.153	.00637	2140.	1000.	5000.	7.827	1884.
55	46	11.674	2.192	7701.	-714.	3.019	7735.	-5.326	17.661	.01496	2616.	861.	5000.	7.827	1884.
67	46	15.000	3.162	7934.	0.	3.174	7934.	0.000	13.444	.01196	2491.	879.	4999.	22.213	5362.
43	47	6.872	0.000	7725.	0.	3.011	7725.	0.000	20.803	.01758	2622.	1000.	5000.	0.000	0.
55	47	11.996	2.089	8404.	1265.	3.686	8501.	8.693	5.810	.00607	2120.	1000.	5000.	6.098	1474.
55	47	11.996	2.089	7718.	-819.	3.039	7762.	-6.057	16.903	.01441	2599.	856.	5000.	6.098	1474.
68	47	15.881	3.162	7981.	0.	3.211	7981.	0.000	12.525	.01127	2461.	879.	4999.	21.257	5160.
44	48	7.484	0.000	7837.	0.	3.097	7837.	0.000	17.705	.01537	2553.	1000.	5000.	0.000	0.
55	48	12.393	1.956	8456.	1177.	3.725	8538.	7.925	5.418	.00573	2095.	1000.	5000.	5.279	1271.
55	48	12.393	1.956	7734.	-946.	3.058	7792.	-6.973	16.056	.01378	2581.	849.	5000.	5.279	1271.
69	48	16.643	3.162	8031.	0.	3.253	8031.	0.000	11.569	.01055	2429.	879.	4999.	21.305	5168.
45	49	8.172	0.000	7982.	0.	3.212	7982.	0.000	14.223	.01280	2461.	1000.	5000.	0.000	0.
55	49	12.938	1.768	8523.	1038.	3.775	8585.	6.915	4.936	.00530	2063.	1000.	5000.	5.355	1286.
55	49	12.938	1.768	7745.	-1124.	3.088	7826.	-8.257	15.071	.01304	2560.	857.	5000.	5.355	1286.
70	49	17.312	3.162	8088.	0.	3.301	8088.	0.000	10.567	.00978	2393.	879.	4999.	22.416	5433.
46	50	9.437	0.000	8184.	0.	3.353	8184.	0.000	10.272	.00976	2331.	1000.	5000.	0.000	0.
55	50	13.713	1.473	8618.	821.	3.842	8649.	5.447	4.335	.00476	2019.	1000.	5000.	3.680	888.
55	50	13.713	1.473	7734.	-1399.	3.116	7862.	-10.252	13.953	.01217	2537.	816.	5000.	3.680	888.
71	50	18.664	3.048	8096.	-30.	3.308	8096.	-.209	10.419	.00967	2388.	878.	5000.	18.438	4468.
71	50	19.025	3.162	8106.	0.	3.316	8156.	0.000	10.265	.00955	2381.	879.	4999.	19.683	4772.

PROPERTIES ALONG THE NOZZLE WALL CONTOUR.

I	X	Y	P	F(1-D)	F(2-D)	ETA(F)	ISP(1-D)	ISP(2-D)	ETA(I)
11	0.00000	1.00000	444.242	3855.	3832.	.9940	198.176	198.942	1.0040
12	.00017	1.00000	424.918	3869.	3832.	1.0060	187.898	198.942	1.0162
13	.00035	1.00001	406.652	3869.	3832.	1.0060	187.899	198.943	1.0162
14	.00052	1.00001	389.830	3869.	3832.	1.0060	187.900	198.943	1.0162
15	.00070	1.00002	373.685	3869.	3832.	1.0060	187.902	198.945	1.0162
16	.00087	1.00004	358.585	3869.	3832.	1.0060	187.904	198.946	1.0162
17	.00105	1.00005	343.686	3869.	3832.	1.0060	187.907	198.948	1.0162
18	.00122	1.00007	329.925	3869.	3832.	1.0060	187.911	198.950	1.0162
19	.00139	1.00010	316.011	3869.	3832.	1.0060	187.914	198.952	1.0162
20	.00156	1.00012	303.024	3869.	3832.	1.0060	187.919	198.955	1.0162
21	.00174	1.00015	290.529	3818.	3832.	1.0060	187.923	198.957	1.0161
22	.00191	1.00018	278.499	3818.	3832.	1.0060	187.929	198.960	1.0161
23	.00208	1.00022	266.909	3818.	3832.	1.0060	187.934	198.963	1.0161
24	.00225	1.00026	255.739	3818.	3832.	1.0059	187.940	198.965	1.0161
25	.00242	1.00030	244.969	3818.	3833.	1.0059	187.947	198.968	1.0161
26	.00259	1.00034	234.583	3818.	3833.	1.0059	187.954	198.972	1.0161
27	.15256	1.04053	236.064	3919.	3885.	.9925	193.318	193.880	1.0026
28	.29176	1.07782	233.036	4001.	3944.	.9858	197.365	196.523	.9957
29	.42175	1.11266	226.856	4068.	3996.	.9821	200.688	199.093	.9921
30	.54538	1.14578	218.612	4126.	4044.	.9802	203.534	201.529	.9901
31	.66437	1.17766	209.133	4177.	4091.	.9794	206.040	203.838	.9893
32	.77974	1.20858	199.031	4222.	4135.	.9793	208.284	206.024	.9892
33	.89203	1.23866	188.755	4263.	4176.	.9795	210.315	208.089	.9894
34	1.00149	1.26797	178.617	4301.	4215.	.9800	212.166	210.031	.9899
35	1.10799	1.29683	168.823	4335.	4252.	.9807	213.861	211.850	.9906
36	1.21195	1.32459	159.490	4367.	4286.	.9815	215.421	213.562	.9914
37	1.31227	1.35127	150.793	4396.	4318.	.9822	216.846	215.142	.9921
38	1.41329	1.37885	142.464	4423.	4348.	.9830	218.194	216.651	.9929
39	1.51136	1.40461	134.581	4449.	4377.	.9838	219.465	218.084	.9937
40	1.61123	1.43137	127.047	4474.	4404.	.9845	220.684	219.463	.9945
41	1.71427	1.45899	119.707	4498.	4432.	.9853	221.882	220.820	.9952
42	1.82551	1.48874	112.289	4523.	4460.	.9860	223.109	222.211	.9960
43	1.95378	1.52316	104.325	4550.	4490.	.9868	224.452	223.729	.9968
44	2.11718	1.56692	95.102	4582.	4526.	.9877	226.049	225.527	.9977
45	2.34641	1.62537	83.710	4624.	4572.	.9888	228.185	227.820	.9988
46	2.70842	1.72322	69.143	4681.	4634.	.9899	230.901	230.882	.9999
47	3.26481	1.87499	51.830	4755.	4712.	.9908	234.582	234.765	1.0008
48	3.81419	2.02164	40.275	4812.	4767.	.9907	237.386	237.551	1.0007
49	4.37731	2.17254	31.829	4858.	4810.	.9900	239.642	239.651	1.0000
50	4.96412	2.32978	25.502	4894.	4840.	.9890	241.429	241.187	.9990
51	5.58177	2.49528	20.663	4922.	4861.	.9877	242.782	242.225	.9977
52	6.23499	2.67031	16.893	4940.	4873.	.9863	243.707	242.794	.9963
53	6.91778	2.85326	13.997	4950.	4875.	.9848	244.191	242.905	.9947
54	7.63905	3.04652	11.678	4951.	4868.	.9833	244.223	242.566	.9932
55	8.07185	3.16228	10.619	4947.	4860.	.9824	244.042	242.166	.9923
55	8.07185	3.16228	28.970	4947.	4860.	.9824	244.042	242.166	.9923
56	8.76419	3.16228	25.646	4947.	4860.	.9824	244.042	242.166	.9923
57	9.23639	3.16228	23.807	4947.	4860.	.9824	244.042	242.166	.9923
58	9.61793	3.16228	23.162	4947.	4860.	.9824	244.042	242.166	.9923
59	9.99168	3.16228	22.443	4947.	4860.	.9824	244.042	242.166	.9923
60	10.35857	3.16228	25.201	4947.	4860.	.9824	244.042	242.166	.9923
61	11.44929	3.16228	20.844	4947.	4860.	.9824	244.042	242.166	.9923
62	11.98568	3.16228	19.299	4947.	4860.	.9824	244.042	242.166	.9923
63	12.58121	3.16228	17.751	4947.	4860.	.9824	244.042	242.166	.9923

I	X	Y	P	F(1-D)	F(2-D)	ETA(F)	ISP(1-D)	ISP(2-D)	ETA(I)
64	13.16189	3.16228	16.483	4947.	4860.	.9824	244.042	242.166	.9923
65	13.79321	3.16228	15.375	4947.	4860.	.9824	244.042	242.166	.9923
66	14.37160	3.16228	14.377	4947.	4860.	.9824	244.042	242.166	.9923
67	15.03764	3.16228	13.444	4947.	4860.	.9824	244.042	242.166	.9923
68	15.84859	3.16228	12.525	4947.	4860.	.9824	244.042	242.166	.9923
69	16.86258	3.16228	11.569	4947.	4860.	.9824	244.042	242.166	.9923
70	18.31153	3.16228	10.567	4947.	4860.	.9824	244.042	242.166	.9923
71	19.82558	3.16228	10.265	4947.	4860.	.9824	244.042	242.166	.9923

PERFORMANCE OF THE SCARFED EXTENSION

I	X	Y	Φ	PSI	CFX	ISPX	CFY	ISPY	ISP
55	8.071	3.162	26.970	0.000	0.	242.166	0.	0.000	242.166
56	8.744	3.162	25.646	25.138	0.	242.166	-.1391E+02	.693	242.166
57	9.256	3.162	23.887	38.410	0.	242.166	-.1736E+02	1.558	242.166
58	9.614	3.162	23.162	44.145	0.	242.166	-.1326E+02	2.218	242.166
59	9.992	3.162	22.443	49.511	0.	242.166	-.1398E+02	2.915	242.166
60	9.992	3.162	22.443	49.511	0.	242.166	0.	2.915	242.166
61	9.992	3.162	22.443	49.511	0.	242.166	0.	2.915	242.166
62	9.992	3.162	22.443	49.511	0.	242.166	0.	2.915	242.166
63	10.559	3.162	25.201	54.383	0.	242.166	-.1667E+02	3.746	242.166
64	10.559	3.162	25.201	54.383	0.	242.166	0.	3.746	242.166
65	11.449	3.162	20.644	67.467	0.	242.166	-.5820E+02	6.247	242.166
66	11.986	3.162	19.259	73.424	0.	242.166	-.1718E+02	7.103	242.166
67	12.581	3.162	17.751	79.631	0.	242.166	-.1403E+02	7.802	242.166
68	13.162	3.162	16.483	85.455	0.	242.166	-.8823E+01	8.242	242.166
69	13.753	3.162	15.375	92.144	0.	242.166	-.4611E+01	8.472	242.166
70	14.372	3.162	14.377	98.645	0.	242.166	-.7004E+00	8.507	242.166
71	15.048	3.162	13.464	105.887	0.	242.166	.5281E+01	8.343	242.166
72	15.861	3.162	12.525	114.741	0.	242.166	.8048E+01	7.942	242.166
73	16.863	3.162	11.569	127.236	0.	242.166	.1468E+02	7.211	242.166
74	18.312	3.162	10.567	150.418	0.	242.166	.2189E+02	6.120	242.166
75	19.025	3.162	10.265	180.000	0.	242.166	.4934E+01	5.874	242.166

```
SUMMARY OF OVERALL SCARFED NOZZLE PERFORMANCE PARAMETERS

  WDOT   =    .[illegible]E+02 LBM/SEC

  FXN    =   -.[illegible]E+04 LBF      ISPXN    =  242.166 (LBF-SEC)/LBM

  FYN    =   -.117[illegible]E+03 LBF      ISPYN    =    5.870 (LBF-SEC)/LBM
SUMMARY OF OVERALL MISSILE PERFORMANCE PARAMETERS

  FXM    =   -.61[illegible]E+04 LBF      ISPXM    =  266.785 (LBF-SEC)/LBM

  FYM    =   -.[illegible]E+04 LBF      ISPYM    =  126.173 (LBF-SEC)/LBM

  ETA    =    .8539                   BETAEFF  =   31.362 DEG
```

APPENDIX C

OUTPUT FOR SAMPLE CASE NO. 4

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NOZZLE GEOMETRIC SPECIFICATIONS -

   THE NOZZLE CROSS-SECTION IS AXISYMMETRIC.

   THE NOZZLE THROAT GEOMETRY IS SPECIFIED BY YT =  1.000 IN.,  RTU =  1.000 IN., AND RTD =   .010 IN.

   THE NOZZLE WALL IS TABULAR, AI=  15.008 DEG.

   THE NOZZLE LENGTH XE =    8.871 IN. AND THE EXIT RADIUS YE =    3.162 IN.

   THE CHARACTERISTIC GRID IS STOPPED AT XMAX = 1000.000 IN.
GEOMETRIC SPECIFICATION OF THE SCARFED EXTENSION.

   XS =    8.871 IN. AND YS =    3.162 IN.

   XF =   19.029 IN., YF =    3.162 IN., AND AF =  0.000 DEG.

   THE SCARF ANGLE BETA = 30.000 DEG.

   THE NOZZLE WALL IS READ IN FROM TAPE5 THROUGH NAMELIST WALL.

   THE TABULAR WALL CONTOUR HAS   3 POINTS.

   I            X              Y

   1         .00739        1.00016
   2        4.03602        2.08131
   3        8.87185        3.16228

$DATA

IUNITS  = 1.

MODE    = 4.

IWALL   = 5.

JWALL   = 0.

NI      = 11.

NT      = 19.

IAS     = 1.

IOUT    = 1.

IWRITE  = 0.

JWRITE  = 0.

KWRITE  = 2.

LWRITE  = 0.

MWRITE  = 0.

NWRITE  = 0.

G       = .120E+01.

RG      = .055E+02.
```

APPENDIX D

OUTPUT FOR SAMPLE CASE NO. 6

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NOZZLE PERFORMANCE PREDICTION PROGRAM.

THIS PROGRAM WILL ANALYZE THE FLOWFIELD AND PERFORMANCE OF PROPULSIVE NOZZLES FOR SEVERAL OPTIONS.
  MODE 1. IRROTATIONAL FLOW ALONG RIGHT-RUNNING CHARACTERISTICS.
  MODE 2. IRROTATIONAL FLOW ALONG LEFT-RUNNING CHARACTERISTICS.
  MODE 3. FLOW WITH AN EMBEDDED RIGHT-RUNNING OBLIQUE SHOCK WAVE.
  MODE 4. FLOW IN A SCARFED NOZZLE EXTENSION.
THE PROGRAM WILL ANALYZE THE PERFORMANCE OF A COMPRESSED PROPULSIVE NOZZLE. ICMP = 1.
THE PROGRAM CAN DETECT AND TRACK AN EMBEDDED RIGHT-RUNNING OBLIQUE SHOCK WAVE (MODE = 3 OR 5).  THE FLOWFIELD AHEAD OF
THE SHOCK WAVE IS ASSUMED TO BE IRROTATIONAL, AND THE FLOWFIELD DOWNSTREAM OF THE SHOCK WAVE IS ASSUMED TO BE ROTATIONAL.
THIS PROGRAM WAS WRITTEN BY JOE D. HOFFMAN, SCHOOL OF MECHANICAL ENGINEERING, PURDUE UNIVERSITY, WEST LAFAYETTE IN 47907.
TELEPHONE NUMBER 317-494-1506.

JOB TITLE =
  SAMPLE CASE NO. 6.  NOMINAL CASE WITH MODE=5

PROBLEM SPECIFICATIONS =
  ANALYSIS OF A SCARFED NOZZLE WITH AN ATTACHED RIGHT-RUNNING OBLIQUE SHOCK WAVE.
  THE ANALYSIS IS PERFORMED IN EE UNITS (LBF, LBM, IN., FT/SEC, R).
  THERE ARE 11 POINTS ALONG THE INITIAL-VALUE LINE, AND 45 POINTS ALONG THE CIRCULAR ARC THROAT CONTOUR.
  THE OUTPUT FLAGS ARE IWRITE =   0, JWRITE =   0, AND KWRITE = 2.
  THE GRID SPACING CONTROL PARAMETERS ARE DXRATIO = 1.000 AND DARATIO = 1.000.
  THE ACCURACY CONTROL PARAMETERS ARE ICORI =  2,  E1 =  0.        , AND E2 =  0.        .

THERMODYNAMIC MODEL =
  G = 1.200,  RG = 65.000 (FT-LBF)/(LBM-R),  PS =  1000. LBF/IN.**2,  TS =  5000. R,  AND  PA = .15. LBF/IN.**2.
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NOZZLE GEOMETRIC SPECIFICATIONS -

    THE NOZZLE CROSS-SECTION IS AXISYMMETRIC.

    THE NOZZLE THROAT GEOMETRY IS SPECIFIED BY YT =  1.000 IN.,  RTU =  1.000 IN., AND RTD =   .010 IN.

    THE NOZZLE CONTOUR IS CONICAL, AA =  15.000 DEG, YE =    3.162 IN., AND EPS =  10.000.

    THE NOZZLE LENGTH XE =    8.071 IN. AND THE EXIT RADIUS YE =    3.162 IN.

    THE CHARACTERISTIC GRID IS STOPPED AT XMAX = 1000.000 IN.
GEOMETRIC SPECIFICATION OF THE SCARFED EXTENSION.

    XE =    8.071 IN. AND YE =    3.162 IN.

    XF =   19.125 IN., YF =    5.162 IN., AND AF =  0.000 DEG.

    THE SCARF ANGLE BETA = 30.000 DEG.

$DATA
IUNITS  = 1.
MODE    = 5.
IWALL   = 1.
JWALL   = 0.
NI      = 11.
NT      = 15.
IVS     = 1.
IOUT    = 1.
IWRITE  = 0.
JWRITE  = 0.
KWRITE  = 2.
LWRITE  = 0.
MWRITE  = 0.
NWRITE  = 0.
G       = .12E+01.
RG      = .65E+02.
PS      = .1E+04.
TS      = .5E+04.
PA      = .1469GE+02.
DELTA   = .1E+01.
YT      = .1E+01.
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```
RTU     = .1E+01,
RTO     = .1E-01,
XK      = .15E+02,
XE      = .35E+02,
EPS     = .1E-02,
TC      = .316227766016838E+00,
XC      = .88720566127952E+01,
EMAX    = .1E+04,
AP      = 0.5,
XP      = .17025497762809E+02,
BETA    = .1E+02,
DYRATIO = .1E+01,
DARATIO = .1E+01,
ICORI   = 2,
ICORR   = 3,
C1      = 0.3,
C2      = 0.5,
IDUMP   = 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
ICND    = 0,
IPLOT   = 0,
ICPLOT  = 0,
TMAX    = .25E+02,
XDES    = 0.0,
YDES    = 0.0,
IS      = 0,
JS      = 0,
&END
```

INITIAL-VALUE LINE SPECIFICATIONS.

INITIAL-VALUE LINE CALCULATED BY THE KLIEGEL-LEVINE METHOD.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
1	11	.282	0.000	3471.	0.	1.031	3471.	0.00	545.67	.26746	4520.	1000.	5000.	0.000	0.
2	10	.268	.100	3475.	7.	1.032	3475.	.11	545.00	.26719	4519.	1000.	5000.	.203	39.
3	9	.252	.200	3485.	13.	1.035	3485.	.21	542.99	.26636	4516.	1000.	5000.	.810	154.
4	8	.239	.300	3502.	19.	1.041	3502.	.30	539.56	.26496	4511.	1000.	5000.	1.823	347.
5	7	.220	.400	3527.	23.	1.049	3527.	.37	534.58	.26292	4504.	1000.	5000.	3.241	617.
6	6	.197	.500	3560.	25.	1.060	3561.	.41	527.79	.26013	4495.	1000.	5000.	5.063	963.
7	5	.168	.600	3605.	25.	1.075	3606.	.40	518.81	.25644	4482.	1000.	5000.	7.288	1387.
8	4	.134	.700	3665.	22.	1.095	3665.	.35	507.42	.25157	4465.	1000.	5000.	9.912	1887.
9	3	.094	.800	3745.	17.	1.121	3745.	.26	49[illegible].54	.24516	4442.	1000.	5000.	12.928	2462.
10	2	.050	.900	3846.	9.	1.156	3846.	.13	471.13	.23665	4411.	1000.	5000.	16.321	3112.
11	1	0.000	1.000	3984.	-0.	1.203	3984.	-.00	444.24	.22534	4368.	1000.	5000.	20.069	3832.

INITIAL-VALUE LINE PERFORMANCE PARAMETERS.

MDOT = 20.069 LBM/SEC. MDOT(1-D) = 20.272 LBM/SEC. CD = .9900

F = 3832. LBF. F(1-D) = 3855. LBF. ETAF = .9940

ISP = 190.942 LBF-SEC/LBM. ISP(1-D) = 190.176 LBF-SEC/LBM. ETAI = 1.0040

IRROTATIONAL FLOWFIELD ALONG RIGHT-RUNNING CHARACTERISTICS EMANATING FROM THE INITIAL-VALUE LINE.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	[illegible]
1	11	.262	0.000	3471.	0.	1.031	3471.	0.000	5[illegible].669	[illegible]746	4520.	1000.	5000.	0.000	0.
2	10	.260	.108	3475.	7.	1.032	3475.	.110	545.005	.26719	4519.	1000.	5000.	.203	39.
2	11	.274	.046	3500.	4.	1.040	3500.	.063	535.787	.[illegible]513	4512.	1000.	5000.	.092	8.
2	12	.[illegible]38	0.000	3525.	0.	1.048	3525.	0.000	534.839	.26333	4505.	1000.	5000.	-.000	-0.
3	9	.252	.208	3485.	13.	1.035	3485.	.214	542.993	.26636	4516.	1000.	5000.	.810	154.
3	10	.270	.137	3505.	12.	1.042	3505.	.198	538.957	.26479	4511.	1000.	5000.	.380	72.
3	11	.286	.084	3531.	9.	1.050	3531.	.155	533.7[illegible]7	.26[illegible]38	4503.	1000.	5000.	.143	27.
3	12	.30[illegible]	.039	3558.	5.	1.059	3558.	.090	528.210	.26031	4495.	1000.	5000.	.031	6.
3	13	.316	0.000	3589.	0.	1.07[illegible]	3589.	0.000	522.875	.25778	4487.	1000.	5000.	-.000	-0.
4	8	.239	.300	3502.	19	1.041	3502.	.303	[illegible]37.563	.26496	4511.	1000.	5000.	1.823	347.
4	9	.263	.229	3515.	20.	1.045	3515.	.321	536.839	.26385	4508.	1000.	5000.	1.065	203.
4	10	.279	.169	3537.	19.	1.052	3537.	.306	532.550	.26209	4502.	1000.	5000.	.578	110.
4	11	.297	.118	3563.	16.	1.061	3563.	.262	527.233	.25998	4494.	1000.	5000.	.279	53.
4	12	.314	.074	359[illegible].	12.	1.071	3592.	.199	521.502	.25755	4486.	1000.	5000.	.109	21.
4	13	.329	.035	3624.	7.	1.081	3624.	.109	515.178	.25494	4477.	1000.	5000.	.024	5.
4	14	.344	0.000	3656.	0.	1.092	3656.	0.000	508.677	.25226	4467.	1000.	5000.	-.000	-0.
5	7	.220	.[illegible]0	3[illegible]27.	23.	1.049	3527.	.371	534.577	.26292	4504.	1000.	5000.	3.241	617.
5	8	.245	.32[illegible]	3532.	26.	1.[illegible]5[illegible]	3532.	.428	533.488	.26247	4503.	1000.	5000.	2.112	402.
5	9	.268	.25[illegible]	3547.	2[illegible].	1.056	3547.	.447	530.408	.26121	4499.	1000.	5000.	1.323	252.
5	10	.289	.198	3570.	27.	1.063	3570.	.433	525.907	.25936	4492.	1000.	5000.	.790	150.
5	11	.308	.148	3597.	24.	1.0[illegible]2	3597.	.390	520.461	.25712	4484.	1000.	5000.	.440	84.
5	12	.326	.105	3627.	21.	1.082	3627.	.326	514.610	.25471	4476.	1000.	5000.	.220	42.
5	13	.[illegible]42	.066	3659.	15.	1.095	3659.	.237	508.192	.25206	4467.	1000.	5000.	.088	17.
5	14	.358	.032	3692.	8.	1.104	3692.	.127	501.549	.24931	4457.	1000.	5000.	.020	4.
5	15	.374	0.000	3726.	0.	1.116	3726.	0.000	494.749	.24649	4447.	1000.	5000.	-.000	-0.
6	6	.197	.508	3560.	25.	1.060	3561.	.406	527.790	.26013	4495.	1000.	5000.	5.063	963.
6	7	.225	.418	3556.	32.	1.059	3556.	.512	528.613	.26047	4496.	1000.	5000.	3.338	673.
6	8	.253	.345	3564.	36.	1.061	3564.	.572	527.046	.25983	4494.	1000.	5000.	2.405	458.
6	9	.277	.280	3581.	37.	1.067	3581.	.593	523.650	.25843	4489.	1000.	5000.	1.590	303.
6	10	.299	.224	3605.	36.	1.075	3605.	.579	518.952	.25650	4482.	1000.	5000.	1.017	194.
6	11	.319	.176	3633.	34.	1.084	3633.	.536	513.384	.25420	4474.	1000.	5000.	.622	119.
6	12	.338	.133	3662.	30	1.094	3663.	.472	507.432	.25175	4465.	1000.	5000.	.358	68.
6	13	.356	.095	3695.	25.	1.105	3695.	.383	500.954	.24906	4456.	1000.	5000.	.183	35.
6	14	.372	.061	3729.	18.	1.116	3729.	.274	494.238	.24628	4446.	1000.	5000.	.075	14.
6	15	.389	.030	3764.	10.	1.128	3764.	.146	487.352	.24341	4435.	1000.	5000.	.017	3.
6	16	.405	0.000	3800.	0.	1.140	3800.	0.000	480.224	.24044	4425.	1000.	5000.	-.000	-0.
7	5	.168	.600	3605.	25.	1.075	3606.	.402	518.807	.25644	4482.	1000.	5000.	7.288	1387.
7	6	.202	.514	3590.	36.	1.070	3591.	.569	521.795	.25767	4486.	1000.	5000.	5.359	1020.
7	7	.233	.436	3589.	43.	1.070	3589.	.673	522.026	.25776	4487.	1000.	5000.	3.852	733.
7	8	.260	.366	3599.	47.	1.073	3599.	.742	520.022	.25694	4484.	1000.	5000.	2.714	517.
7	9	.286	.30[illegible]	3618.	48.	1.079	3618.	.764	516.530	.25542	4478.	1000.	5000.	1.874	357.
7	10	.309	.251	3642.	48.	1.087	3642.	.751	511.443	.25340	4471.	1000.	5000.	1.266	241.
7	11	.331	.203	3671.	45.	1.097	3671.	.708	505.752	.25105	4463.	1000.	5000.	.830	156.
7	12	.351	.162	3701.	42.	1.107	3701.	.644	499.708	.24855	4454.	1000.	5000.	.525	100.
7	13	.369	.124	3734.	36.	1.118	3734.	.554	493.176	.24584	444[illegible].	1000.	5000.	.309	59.
7	14	.387	.090	3768.	29.	1.130	3769.	.444	486.422	.24303	4434.	1000.	5000.	.163	31.
7	15	.404	.059	3804.	21.	1.142	3804.	.317	479.469	.24013	4423.	1000.	5000.	.069	13.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
7	16	.421	.029	3840.	11.	1.154	3840.	.171	472.264	.23712	4412.	1000.	5000.	.017	3.
7	17	.438	0.000	3879.	0.	1.157	3879.	0.000	464.615	.23391	4400.	1000.	5000.	-.000	-0.
8	4	.134	.700	3665.	22.	1.095	3665.	.351	507.020	.25157	4465.	1000.	5000.	9.912	1887.
8	5	.173	.612	3637.	38.	1.096	3638.	.599	512.409	.25380	4473.	1000.	5000.	7.587	1444.
8	6	.208	.531	3626.	49.	1.082	3626.	.773	514.684	.25474	4476.	1000.	5000.	5.697	1084.
8	7	.240	.456	3628.	56.	1.083	3628.	.887	514.332	.25459	4476.	1000.	5000.	4.207	801.
8	8	.269	.389	3640.	61.	1.087	3640.	.953	511.898	.25359	4472.	1000.	5000.	3.062	583.
8	9	.296	.330	3660.	62.	1.093	3660.	.977	507.911	.25194	4466.	1000.	5000.	2.198	419.
8	10	.321	.278	3685.	62.	1.102	3686.	.964	502.828	.24984	4459.	1000.	5000.	1.554	296.
8	11	.344	.232	3715.	60.	1.112	3715.	.921	497.009	.24743	4450.	1000.	5000.	1.079	206.
8	12	.365	.191	3746.	56.	1.122	3746.	.856	490.871	.24488	4441.	1000.	5000.	.732	140.
8	13	.385	.154	3779.	50.	1.133	3779.	.766	484.286	.24214	4431.	1000.	5000.	.476	91.
8	14	.403	.121	3813.	44.	1.145	3814.	.656	477.496	.23931	4420.	1000.	5000.	.291	56.
8	15	.421	.090	3849.	35.	1.157	3849.	.520	470.518	.23639	4410.	1000.	5000.	.161	31.
8	16	.439	.061	3886.	26.	1.170	3886.	.382	463.279	.23335	4398.	1000.	5000.	.072	14.
8	17	.456	.031	3926.	14.	1.183	3926.	.211	455.535	.23010	4386.	1000.	5000.	.019	4.
8	18	.478	0.000	3971.	0.	1.199	3971.	0.000	446.819	.22642	4372.	1000.	5000.	-.001	-0.
9	3	.098	.800	3743.	17.	1.121	3743.	.256	491.543	.24516	4442.	1000.	5000.	12.928	2462.
9	4	.139	.711	3702.	40.	1.107	3702.	.612	499.562	.24899	4454.	1000.	5000.	10.231	1948.
9	5	.179	.628	3679.	56.	1.100	3679.	.870	504.074	.25036	4461.	1000.	5000.	7.966	1516.
9	6	.216	.550	3671.	67.	1.097	3672.	1.051	505.575	.25098	4463.	1000.	5000.	6.116	1164.
9	7	.250	.479	3676.	75.	1.099	3677.	1.170	504.606	.25058	4461.	1000.	5000.	4.642	884.
9	8	.281	.416	3690.	80.	1.104	3691.	1.238	501.715	.24938	4457.	1000.	5000.	3.488	665.
9	9	.309	.359	3712.	82.	1.111	3713.	1.263	497.408	.24759	4451.	1000.	5000.	2.599	496.
9	10	.335	.309	3739.	82.	1.120	3740.	1.251	492.107	.24539	4443.	1000.	5000.	1.918	366.
9	11	.360	.264	3769.	79.	1.130	3770.	1.207	486.145	.24291	4434.	1000.	5000.	1.400	268.
9	12	.382	.225	3801.	76.	1.141	3802.	1.142	479.904	.24031	4424.	1000.	5000.	1.010	193.
9	13	.403	.189	3835.	70.	1.152	3835.	1.050	473.260	.23754	4414.	1000.	5000.	.710	136.
9	14	.423	.156	3870.	63.	1.164	3870.	.940	466.436	.23468	4403.	1000.	5000.	.483	93.
9	15	.442	.126	3905.	55.	1.176	3906.	.811	459.440	.23174	4392.	1000.	5000.	.311	60.
9	16	.461	.096	3943.	46.	1.189	3943.	.664	452.189	.22869	4380.	1000.	5000.	.182	35.
9	17	.481	.067	3983.	34.	1.203	3983.	.493	444.427	.22541	4368.	1000.	5000.	.087	17.
9	18	.502	.036	4028.	20.	1.219	4029.	.281	435.614	.22168	4353.	1000.	5000.	.024	5.
9	19	.528	0.000	4084.	0.	1.238	4084.	0.000	424.917	.21714	4335.	1000.	5000.	-.001	-0.
10	2	.050	.900	3846.	9.	1.156	3846.	.128	471.151	.23665	4411.	1000.	5000.	16.321	3112.
10	3	.100	.811	3790.	42.	1.137	3791.	.633	482.033	.24120	4427.	1000.	5000.	13.294	2532.
10	4	.146	.727	3755.	66.	1.125	3756.	1.004	488.931	.24407	4438.	1000.	5000.	10.685	2035.
10	5	.189	.648	3737.	83.	1.120	3738.	1.272	492.406	.24552	4443.	1000.	5000.	8.489	1617.
10	6	.227	.575	3734.	95.	1.118	3735.	1.461	493.026	.24577	4444.	1000.	5000.	6.682	1273.
10	7	.263	.509	3742.	104.	1.121	3744.	1.585	491.361	.24508	4442.	1000.	5000.	5.221	995.
10	8	.296	.449	3759.	109.	1.127	3761.	1.656	487.955	.24367	4436.	1000.	5000.	4.057	774.
10	9	.326	.396	3783.	111.	1.135	3784.	1.681	483.281	.24172	4429.	1000.	5000.	3.137	599.
10	10	.354	.348	3811.	111.	1.145	3813.	1.669	477.729	.23940	4421.	1000.	5000.	2.415	462.
10	11	.380	.305	3842.	109.	1.155	3844.	1.624	471.599	.23684	4411.	1000.	5000.	1.849	354.
10	12	.404	.267	3875.	105.	1.166	3876.	1.557	465.242	.23418	4401.	1000.	5000.	1.410	270.
10	13	.427	.232	3909.	100.	1.178	3910.	1.464	458.533	.23136	4391.	1000.	5000.	1.059	203.
10	14	.449	.199	3944.	93.	1.190	3946.	1.352	451.676	.22847	4380.	1000.	5000.	.782	150.
10	15	.469	.169	3981.	85.	1.203	3982.	1.222	444.669	.22552	4368.	1000.	5000.	.561	108.
10	16	.490	.141	4018.	75.	1.216	4019.	1.074	437.425	.22245	4356.	1000.	5000.	.384	74.
10	17	.511	.112	4059.	64.	1.230	4059.	.901	429.679	.21916	4343.	1000.	5000.	.241	47.
10	18	.534	.081	4105.	49.	1.246	4105.	.689	420.886	.21542	4328.	1000.	5000.	.125	24.
10	19	.562	.045	4162.	29.	1.266	4162.	.406	410.097	.21081	4310.	1000.	5000.	.037	7.
10	20	.598	0.000	4236.	0.	1.292	4236.	0.000	396.090	.20479	4285.	1000.	5000.	-.002	-0.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	[illegible]
11	1	0.000	1.000	3984.	-0.	1.203	3984.	-.000	446.242	.22534	4360.	1000.	5000.	20.019	3832.
11	2	.057	.913	3912.	48.	1.179	3912.	.708	458.251	.25124	4390.	1000.	5000.	16.771	3190.
11	3	.110	.824	3863.	83.	1.162	3864.	1.235	467.684	.23519	4405.	1000.	5000.	13.867	2643.
11	4	.154	.750	3834.	108.	1.153	3836.	1.620	473.169	.23750	4414.	1000.	5000.	11.363	2168.
11	5	.203	.677	3822.	127.	1.149	3824.	1.901	475.412	.23844	4417.	1000.	5000.	9.245	1762.
11	6	.244	.610	3824.	140.	1.149	3826.	2.098	475.814	.23827	4417.	1000.	5000.	7.483	1427.
11	7	.283	.546	3836.	149.	1.154	3839.	2.226	472.559	.23724	4413.	1000.	5000.	6.034	1152.
11	8	.318	.493	3856.	155.	1.160	3859.	2.298	468.564	.23557	4407.	1000.	5000.	4.855	928.
11	9	.351	.442	3882.	157.	1.167	3885.	2.323	463.476	.23345	4399.	1000.	5000.	3.900	747.
11	10	.381	.397	3912.	158.	1.178	3915.	2.309	457.627	.23098	4389.	1000.	5000.	3.130	600.
11	11	.410	.356	3944.	156.	1.191	3948.	2.262	451.304	.22832	4379.	1000.	5000.	2.509	482.
11	12	.436	.320	3978.	152.	1.202	3981.	2.191	444.021	.22558	4369.	1000.	5000.	2.012	387.
11	13	.461	.286	4013.	147.	1.214	4016.	2.096	438.047	.22271	4357.	1000.	5000.	1.602	309.
11	14	.484	.255	4049.	140.	1.227	4052.	1.981	431.167	.21979	4346.	1000.	5000.	1.266	246.
11	15	.507	.226	4086.	132.	1.240	4088.	1.849	424.167	.21682	4334.	1000.	5000.	.986	191.
11	16	.529	.198	4124.	122.	1.253	4126.	1.699	416.955	.21374	4322.	1000.	5000.	.751	146.
11	17	.552	.169	4165.	111.	1.267	4166.	1.524	409.264	.21045	4308.	1000.	5000.	.547	106.
11	18	.577	.139	4212.	96.	1.283	4213.	1.309	400.551	.20671	4293.	1000.	5000.	.365	71.
11	19	.608	.103	4269.	76.	1.304	4270.	1.024	389.066	.20216	4274.	1000.	5000.	.199	39.
11	20	.647	.059	4345.	47.	1.331	4346.	.615	375.804	.19681	4247.	1000.	5000.	.062	12.
11	21	.701	0.000	4430.	0.	1.369	4430.	0.000	356.905	.18776	4211.	1000.	5000.	-.003	-0.

IRROTATIONAL FLOWFIELD ALONG LEFT-RUNNING CHARACTERISTICS EMANATING FROM THE DOWNSTREAM EXTENT OF THE INITIAL-VALUE LINE.

I	J	X	Y	U	V	M	WMAG	THETA	P	RHO	T	PT	TT	MDOT	F
11	1	0.000	1.000	3984.	-0.	1.203	3984.	-.000	444.242	.22534	4368.	1000.	5000.	20.069	3832.
11	2	.057	.913	3912.	48.	1.179	3912.	.708	458.251	.23124	4390.	1000.	5000.	16.771	3196.
12	1	.000	1.000	4084.	71.	1.258	4084.	1.000	424.910	.21713	4335.	1000.	5000.	20.069	3832.
12		F =	3832.0	F10 =		3809.0	ETAF =1.0060		ISP =	190.942		ISP10 =	187.898		ETAI =1.0162
12	2	.061	.919	4020.	123.	1.216	4022.	1.746	436.908	.22223	4355.	1000.	5000.	16.984	3239.
13	1	.000	1.000	4177.	146.	1.272	4179.	2.000	406.852	.20942	4304.	1000.	5000.	20.069	3832.
13		F =	3832.0	F10 =		3809.0	ETAF =1.0060		ISP =	190.943		ISP10 =	187.899		ETAI =1.0162
13	2	.064	.924	4120.	200.	1.252	4124.	2.778	417.250	.21387	4322.	1000.	5000.	17.157	3275.
14	1	.001	1.000	4264.	223.	1.304	4270.	3.000	389.830	.20209	4273.	1000.	5000.	20.070	3832.
14		F =	3832.1	F10 =		3809.1	ETAF =1.0060		ISP =	190.943		ISP10 =	187.900		ETAI =1.0162
14	2	.067	.928	4212.	280.	1.287	4221.	3.806	398.853	.20600	4290.	1000.	5000.	17.304	3302.
15	1	.001	1.000	4347.	304.	1.335	4357.	4.000	373.685	.19509	4243.	1000.	5000.	20.070	3832.
15		F =	3832.1	F10 =		3809.1	ETAF =1.0060		ISP =	190.945		ISP10 =	187.902		ETAI =1.0162
15	2	.070	.932	4299.	363.	1.320	4314.	4.830	381.598	.19853	4258.	1000.	5000.	17.433	3329.
16	1	.001	1.000	4425.	387.	1.366	4442.	5.000	358.305	.18837	4214.	1000.	5000.	20.070	3832.
16		F =	3832.1	F10 =		3809.2	ETAF =1.0060		ISP =	190.946		ISP10 =	187.904		ETAI =1.0162
16	2	.073	.935	4381.	449.	1.352	4404.	5.852	365.206	.19139	4227.	1000.	5000.	17.547	3351.
17	1	.001	1.000	4499.	473.	1.396	4524.	6.000	343.606	.18191	4185.	1000.	5000.	20.070	3832.
17		F =	3832.1	F10 =		3809.2	ETAF =1.0060		ISP =	190.948		ISP10 =	187.907		ETAI =1.0162
17	2	.075	.939	4458.	537.	1.384	4490.	6.871	349.602	.18455	4197.	1000.	5000.	17.650	3371.
18	1	.001	1.000	4569.	561.	1.426	4604.	7.000	329.525	.17568	4155.	1000.	5000.	20.070	3832.
18		F =	3832.2	F10 =		3809.3	ETAF =1.0060		ISP =	190.950		ISP10 =	187.911		ETAI =1.0162
18	2	.078	.942	4531.	628.	1.415	4574.	7.889	334.702	.17798	4166.	1000.	5000.	17.745	3391.
19	1	.001	1.000	4636.	652.	1.455	4682.	8.000	316.011	.16965	4127.	1000.	5000.	20.070	3832.
19		F =	3832.2	F10 =		3809.4	ETAF =1.0060		ISP =	190.952		ISP10 =	187.914		ETAI =1.0163
19	2	.080	.945	4600.	721.	1.445	4656.	8.905	320.441	.17163	4136.	1000.	5000.	17.832	3409.
20	1	.002	1.000	4700.	744.	1.484	4758.	9.000	303.024	.16382	4098.	1000.	5000.	20.070	3832.
20		F =	3832.3	F10 =		3809.4	ETAF =1.0060		ISP =	190.955		ISP10 =	187.919		ETAI =1.0162
20	2	.082	.948	4665.	810.	1.475	4736.	9.920	306.766	.16551	4106.	1000.	5000.	17.913	3425.
21	1	.002	1.000	4760.	835.	1.512	4833.	10.000	290.529	.15817	4069.	1000.	5000.	20.070	3833.
21		F =	3832.3	F10 =		3809.5	ETAF =1.0060		ISP =	190.957		ISP10 =	187.923		ETAI =1.0161

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	[illegible]	[illegible]
21	2	.084	.951	4727.	913.	1.518	4815.	10.930	293.687	.15968	4076.	1000.	5000.	[illegible]	[illegible]
22	1	.082	1.000	4817.	916.	1.541	4907.	11.000	278.939	.15276	4801.	1000.	5000.	20.070	[illegible]
22		F =	3832.4	FID =		3849.6	ETAF =1.0068		ISP = 198.960		ISPID = 187.929			ETAI =1.0161	
22	2	.086	.953	4785.	1012.	1.535	4891.	11.945	281.619	.15385	4087.	1000.	5006.	18.068	3086.
23	1	.082	1.000	4871.	1035.	1.565	4979.	12.000	266.909	.14738	4012.	1000.	5000.	20.070	3033.
23		F =	3832.4	FID =		3849.8	ETAF =1.0068		ISP = 198.963		ISPID = 187.934			ETAI =1.0162	
23	2	.088	.956	4848.	1114.	1.564	4967.	12.956	268.061	.14829	4017.	1000.	5000.	18.128	3071.
24	1	.082	1.000	4921.	1136.	1.597	5051.	13.000	255.739	.14222	3984.	1000.	5000.	20.070	3033.
24		F =	3832.5	FID =		3822.9	ETAF =1.0059		ISP = 198.965		ISPID = 187.940			ETAI =1.0161	
24	2	.090	.959	4892.	1217.	1.594	5041.	13.966	257.288	.14290	3987.	1000.	5000.	18.192	3084.
25	1	.082	1.000	4967.	1239.	1.625	5121.	14.000	244.969	.13722	3955.	1000.	5060.	20.079	3833.
25		F =	3832.6	FID =		3818.8	ETAF =1.0059		ISP = 198.968		ISPID = 187.947			ETAI =2.0161	
25	2	.092	.961	4981.	1322.	1.623	5116.	14.975	245.954	.13758	3958.	1000.	5000.	18.253	3497.
26	1	.083	1.000	5013.	1343.	1.653	5190.	15.000	234.583	.13235	3927.	1000.	5000.	20.070	3633.
26		F =	3832.6	FID =		3919.2	ETAF =1.0059		ISP = 198.972		ISPID = 187.954			ETAI =1.0161	
26	2	.094	.964	4986.	1428.	1.653	5186.	15.984	238.124	.13260	3928.	1000.	5000.	18.311	35[illegible].
27	2	.853	1.041	5004.	1351.	1.649	5188.	15.000	236.064	.13305	3931.	1000.	5000.	20.069	3889.
27		F =	3889.5	FID =		3919.7	ETAF = .9925		ISP = 195.800		ISPID = 193.[illegible]			ETAI =1.0026	

CONTINUATION OF THE IRROTATIONAL FLOWFIELD ALONG RIGHT-RUNNING CHARACTERISTICS

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
11	3	.110	.829	3863.	83.	1.162	3864.	1.233	467.664	.23519	4405.	1000.	5000.	13.867	2643.
12	3	.117	.842	3980.	160.	1.203	3983.	2.306	444.410	.22541	4368.	1000.	5000.	14.276	2722.
13	3	.124	.852	4086.	240.	1.241	4095.	3.365	423.297	.21645	4333.	1000.	5000.	14.602	2786.
14	3	.130	.861	4183.	323.	1.277	4196.	4.417	403.758	.20809	4299.	1000.	5000.	14.876	2839.
15	3	.135	.869	4274.	409.	1.312	4293.	5.461	385.466	.20020	4265.	1000.	5000.	15.113	2887.
16	3	.142	.876	4359.	497.	1.346	4387.	6.500	368.210	.19270	4233.	1000.	5000.	15.324	2929.
17	3	.145	.882	4439.	587.	1.379	4478.	7.536	351.845	.18554	4201.	1000.	5000.	15.514	2967.
18	3	.149	.888	4514.	680.	1.411	4565.	8.567	336.264	.17867	4169.	1000.	5000.	15.687	3003.
19	3	.153	.894	4596.	775.	1.443	4651.	9.595	321.388	.17206	4138.	1000.	5000.	15.847	3036.
20	3	.158	.900	4653.	872.	1.475	4734.	10.621	307.156	.16568	4107.	1000.	5000.	15.996	3066.
21	3	.162	.905	4716.	972.	1.506	4815.	11.644	293.518	.15953	4076.	1000.	5000.	16.135	3095.
22	3	.166	.910	4776.	1073.	1.536	4895.	12.665	280.434	.15358	4045.	1000.	5000.	16.266	3123.
23	3	.169	.916	4832.	1176.	1.567	4973.	13.684	267.868	.14782	4014.	1000.	5000.	16.389	3149.
24	3	.173	.921	4885.	1282.	1.597	5050.	14.701	255.794	.14225	3984.	1000.	5000.	16.507	3174.
25	3	.177	.926	4934.	1388.	1.627	5126.	15.716	244.186	.13685	3953.	1000.	5000.	16.619	3198.
26	3	.181	.931	4981.	1497.	1.658	5201.	16.730	233.022	.13162	3922.	1000.	5000.	16.725	3221.
27	3	.237	1.007	4999.	1401.	1.654	5191.	15.654	234.410	.13227	3926.	1000.	5000.	18.376	3578.
28	3	.292	1.078	5023.	1345.	1.658	5201.	15.000	233.036	.13162	3922.	1000.	5000.	20.069	3944.
28		F =	3944.0	FID =		4000.9	ETAF = .9858		ISP =	196.523		ISPID =	197.365	ETAI =	.9957
11	4	.158	.752	3834.	108.	1.153	3836.	1.620	473.169	.23750	4414.	1000.	5000.	11.363	2165.
12	4	.173	.773	3959.	144.	1.196	3964.	2.721	448.180	.22700	4374.	1000.	5000.	11.941	2277.
13	4	.179	.786	4071.	271.	1.237	4080.	3.804	425.791	.21751	4337.	1000.	5000.	12.396	2366.
14	4	.188	.799	4173.	356.	1.275	4188.	4.873	405.240	.20872	4301.	1000.	5000.	12.774	2441.
15	4	.195	.810	4267.	443.	1.311	4290.	5.933	386.108	.20048	4267.	1000.	5000.	13.101	2506.
16	4	.202	.821	4355.	534.	1.346	4388.	6.985	368.134	.19267	4233.	1000.	5000.	13.391	2564.
17	4	.209	.832	4438.	626.	1.380	4482.	8.032	351.144	.18523	4200.	1000.	5000.	13.652	2617.
18	4	.216	.839	4515.	721.	1.414	4572.	9.073	335.014	.17811	4167.	1000.	5000.	13.890	2665.
19	4	.222	.848	4588.	818.	1.447	4661.	10.110	319.650	.17128	4134.	1000.	5000.	14.109	2711.
20	4	.228	.856	4657.	917.	1.479	4747.	11.142	304.981	.16470	4102.	1000.	5000.	14.314	2753.
21	4	.234	.864	4722.	1019.	1.512	4831.	12.172	290.951	.15837	4070.	1000.	5000.	14.505	2793.
22	4	.240	.872	4783.	1122.	1.543	4913.	13.198	277.514	.15225	4038.	1000.	5000.	14.685	2831.
23	4	.245	.879	4841.	1227.	1.575	4994.	14.221	264.632	.14633	4006.	1000.	5000.	14.856	2867.
24	4	.251	.887	4895.	1334.	1.606	5073.	15.241	252.273	.14062	3974.	1000.	5000.	15.018	2902.
25	4	.256	.894	4945.	1442.	1.638	5151.	16.259	240.409	.13508	3943.	1000.	5000.	15.172	2935.
26	4	.261	.902	4992.	1552.	1.669	5228.	17.275	229.016	.12973	3911.	1000.	5000.	15.320	2967.
27	4	.316	.976	5010.	1448.	1.664	5215.	16.117	230.896	.13061	3916.	1000.	5000.	16.862	3301.
28	4	.372	1.047	5035.	1387.	1.666	5222.	15.400	229.837	.13012	3913.	1000.	5000.	18.465	3648.
29	4	.421	1.113	5064.	1357.	1.675	5245.	15.000	226.856	.12871	3905.	1000.	5000.	20.068	3995.
29		F =	3995.6	FID =		4066.3	ETAF = .9821		ISP =	195.093		ISPID =	200.688	ETAI =	.9921
11	5	.203	.677	3822.	127.	1.149	3824.	1.901	475.412	.23844	4417.	1000.	5000.	9.245	1762.
12	5	.218	.704	3954.	209.	1.195	3960.	3.025	448.926	.22731	4375.	1000.	5000.	9.955	1900.
13	5	.232	.725	4071.	294.	1.237	4081.	4.125	425.465	.21737	4336.	1000.	5000.	10.509	2008.
14	5	.241	.742	4177.	381.	1.277	4194.	5.208	404.075	.20822	4299.	1000.	5000.	10.968	2099.
15	5	.252	.757	4274.	470.	1.315	4300.	6.279	384.255	.19968	4263.	1000.	5000.	11.365	2178.
16	5	.261	.771	4365.	562.	1.351	4401.	7.341	365.782	.19161	4228.	1000.	5000.	11.716	2248.
17	5	.270	.783	4450.	657.	1.386	4498.	8.395	348.216	.18394	4194.	1000.	5000.	12.033	2313.
18	5	.278	.795	4529.	755.	1.421	4592.	9.442	331.655	.17662	4160.	1000.	5000.	12.323	2372.
19	5	.286	.806	4604.	852.	1.455	4682.	10.484	315.925	.16961	4126.	1000.	5000.	12.590	2427.
20	5	.294	.817	4675.	953.	1.489	4771.	11.521	300.917	.16287	4093.	1000.	5000.	12.839	2479.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	ROOT	F
21	5	.302	.827	4741.	1356.	1.522	4857.	12.554	286.595	.15639	4060.	1000.	5000.	13.075	2528.
22	5	.309	.837	4803.	1161.	1.558	4942.	13.582	272.909	.15014	4027.	1000.	5000.	13.293	2575.
23	5	.316	.847	4862.	1267.	1.587	5024.	14.607	259.806	.14411	3994.	1000.	5000.	13.502	2619.
24	5	.323	.856	4917.	1376.	1.619	5106.	15.629	247.255	.13828	3961.	1000.	5000.	13.700	2661.
25	5	.330	.866	4968.	1486.	1.652	5186.	16.647	235.226	.13265	3928.	1000.	5000.	13.889	2702.
26	5	.337	.875	5016.	1597.	1.684	5264.	17.662	223.692	.12721	3896.	1000.	5000.	14.071	2741.
27	5	.391	.948	5534.	1484.	1.677	5248.	16.430	226.083	.12834	3903.	1000.	5000.	15.507	3053.
28	5	.444	1.018	5058.	1418.	1.679	5253.	15.657	225.376	.12801	3901.	1000.	5000.	17.020	3382.
29	5	.494	1.044	5087.	1383.	1.687	5272.	15.214	222.640	.12671	3893.	1000.	5000.	18.548	3714.
30	5	.545	1.146	5119.	1372.	1.698	5300.	15.000	218.612	.12480	3881.	1000.	5000.	20.067	4044.

32 F = 4344.5 F10 = 4126.0 ETAF = .9802 ISP = 201.529 ISPIO = 203.534 ETAI = .9901

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	ROOT	F
11	6	.244	.610	3826.	140.	1.149	3826.	2.098	475.014	.23827	4417.	1000.	5000.	7.483	1427.
12	6	.263	.643	3962.	224.	1.198	3968.	3.239	447.296	.22663	4373.	1000.	5000.	8.283	1582.
13	6	.274	.667	4085.	311.	1.242	4094.	4.352	422.960	.21630	4332.	1000.	5000.	8.907	1704.
14	6	.292	.695	4195.	400.	1.283	4211.	5.445	400.893	.20686	4293.	1000.	5000.	9.424	1807.
15	6	.304	.706	4292.	491.	1.322	4320.	6.524	380.526	.19806	4256.	1000.	5000.	9.872	1896.
16	6	.316	.725	4385.	585.	1.359	4424.	7.592	361.518	.18978	4220.	1000.	5000.	10.269	1976.
17	6	.326	.740	4472.	683.	1.396	4524.	6.651	343.648	.18193	4185.	1000.	5000.	10.628	2049.
18	6	.337	.754	4554.	779.	1.432	4620.	9.703	326.761	.17445	4150.	1000.	5000.	10.957	2117.
19	6	.346	.767	4630.	879.	1.467	4713.	10.747	310.743	.16729	4115.	1000.	5000.	11.261	2180.
20	6	.356	.780	4703.	981.	1.501	4803.	11.786	295.509	.16043	4081.	1000.	5000.	11.545	2239.
21	6	.365	.791	4770.	1085.	1.535	4892.	12.820	280.990	.15383	4047.	1000.	5000.	11.812	2295.
22	6	.374	.805	4833.	1193.	1.569	4978.	13.849	267.131	.14749	4013.	1000.	5000.	12.064	2348.
23	6	.383	.817	4893.	1300.	1.602	5063.	14.874	253.889	.14137	3979.	1000.	5000.	12.303	2399.
24	6	.391	.828	4949.	1409.	1.635	5146.	15.895	241.224	.13547	3945.	1000.	5000.	12.531	2448.
25	6	.429	.847	5001.	1521.	1.668	5227.	16.912	229.106	.12977	3911.	1000.	5000.	12.749	2495.
26	6	.430	.853	5050.	1634.	1.701	5308.	17.925	217.505	.12427	3877.	1000.	5000.	12.957	2541.
27	6	.461	.922	5066.	1513.	1.693	5287.	16.625	220.407	.12565	3886.	1000.	5000.	14.293	2832.
28	6	.514	.991	5095.	1466.	1.694	5290.	15.801	220.068	.12549	3885.	1000.	5000.	15.718	3142.
29	6	.566	1.057	5118.	1407.	1.701	5307.	15.320	217.604	.12432	3878.	1000.	5000.	17.170	3458.
30	6	.616	1.119	5150.	1387.	1.712	5334.	15.076	213.786	.12250	3866.	1000.	5000.	18.626	3776.
31	6	.664	1.178	5184.	1389.	1.726	5367.	15.000	209.135	.12027	3852.	1000.	5000.	20.067	4090.

31 F = 4390.4 F10 = 4176.8 ETAF = .9794 ISP = 203.838 ISPIO = 206.040 ETAI = .9893

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	ROOT	F
11	7	.283	.544	3836.	140.	1.154	3839.	2.226	472.559	.23724	4413.	1000.	5000.	6.034	1153.
12	7	.305	.587	3978.	235.	1.204	3986.	3.381	443.857	.22517	4367.	1000.	5000.	6.867	1318.
13	7	.323	.617	4103.	323.	1.249	4116.	4.503	418.827	.21454	4325.	1000.	5000.	7.553	1448.
14	7	.339	.643	4215.	414.	1.292	4236.	5.603	396.227	.20485	4285.	1000.	5000.	8.109	1558.
15	7	.353	.663	4318.	506.	1.332	4348.	6.688	375.432	.19585	4247.	1000.	5000.	8.591	1655.
16	7	.367	.682	4413.	601.	1.370	4454.	7.760	356.075	.18740	4209.	1000.	5000.	9.020	1741.
17	7	.379	.700	4502.	699.	1.408	4556.	8.822	337.918	.17940	4173.	1000.	5000.	9.409	1821.
18	7	.391	.717	4585.	798.	1.444	4654.	9.875	320.794	.17179	4137.	1000	5000.	9.767	1894.
19	7	.403	.732	4663.	900.	1.480	4749.	10.921	304.581	.16452	4101.	1000.	5000.	10.098	1963.
20	7	.414	.747	4736.	1003.	1.516	4841.	11.960	289.189	.15757	4066.	1000.	5000.	10.409	2028.
21	7	.425	.762	4805.	1109.	1.551	4931.	12.993	274.543	.15089	4031.	1000.	5000.	10.701	2090.
22	7	.435	.776	4870.	1216.	1.585	5019.	14.022	260.587	.14447	3996.	1000.	5000.	10.978	2149.
23	7	.446	.789	4931.	1325.	1.619	5106.	15.045	247.272	.13829	3961.	1000.	5000.	11.241	2205.
24	7	.456	.803	4988.	1436.	1.653	5190.	16.064	234.559	.13234	3927.	1000.	5000.	11.492	2259.
25	7	.466	.817	5041.	1549.	1.687	5273.	17.078	222.412	.12660	3892.	1000.	5000.	11.732	2311.
26	7	.476	.830	5090.	1663.	1.721	5355.	18.089	210.803	.12107	3857.	1000.	5000.	11.963	2361.
27	7	.528	.899	5105.	1534.	1.711	5331.	16.727	214.205	.12270	3868.	1000.	5000.	13.233	2632.
28	7	.581	.967	5128.	1457.	1.711	5331.	15.857	214.238	.12271	3868.	1000.	5000.	14.543	2925.
29	7	.633	1.032	5156.	1414.	1.717	5346.	15.341	212.059	.12167	3861.	1000.	5000.	15.923	3226.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
30	7	.683	1.094	5187.	1397.	1.727	5372.	15.070	208.467	.11995	3850.	1000.	5000.	17.315	3531.
31	7	.732	1.153	5221.	1396.	1.742	5404.	14.974	204.001	.11781	3836.	1000.	5000.	18.701	3834.
32	7	.780	1.209	5255.	1408.	1.757	5441.	15.000	199.031	.11541	3821.	1000.	5000.	20.066	4134.
32		F X =	4134.7	FID =		4222.3	ETAF = .9795		ISP =	206.024	ISPID =		208.284	ETAI =	.9892
11	8	.318	.493	385[illegible].	155.	1.160	3859.	2.296	468.564	.23557	4407.	1000.	5000.	4.855	928.
12	8	.343	.497	4003.	242.	1.213	4010.	3.463	439.095	.22316	4359.	1000.	5000.	5.727	1097.
13	8	.364	.571	4131.	332.	1.259	4144.	4.591	413.523	.21227	4316.	1000.	5000.	6.413	1232.
14	8	.383	.592	4245.	423.	1.305	4266.	5.697	390.509	.20238	4275.	1000.	5000.	6.990	1347.
15	8	.399	.622	4350.	518.	1.344	4381.	6.785	369.389	.19322	4235.	1000.	5000.	7.493	1448.
16	8	.415	.644	4447.	614.	1.383	4489.	7.859	349.773	.18463	4197.	1000.	5000.	7.943	1539.
17	8	.429	.664	4537.	712.	1.422	4595.	8.922	331.410	.17652	4159.	1000.	5000.	8.352	1622.
18	8	.443	.682	4622.	813.	1.459	4695.	9.976	314.122	.16881	4122.	1000.	5000.	8.730	1700.
19	8	.456	.700	4701.	916.	1.496	4790.	11.022	297.784	.16146	4086.	1000.	5000.	9.081	1773.
20	8	.469	.717	4776.	1020.	1.532	4884.	12.060	282.298	.15443	4050.	1000.	5000.	9.411	1845.
21	8	.481	.733	4846.	1127.	1.568	4975.	13.092	267.587	.14770	4014.	1000.	5000.	9.722	1909.
22	8	.493	.749	4912.	1235.	1.603	5064.	14.119	253.591	.14123	3978.	1000.	5000.	10.017	1972.
23	8	.505	.765	4973.	1346.	1.638	5152.	15.140	240.259	.13501	3942.	1000.	5000.	10.299	2032.
24	8	.517	.780	5031.	1457.	1.673	5238.	16.156	227.550	.12904	3907.	1000.	5000.	10.568	2090.
25	8	.528	.795	5085.	1571.	1.708	5322.	17.167	215.425	.12328	3871.	1000.	5000.	10.826	2146.
26	8	.549	.810	5136.	1686.	1.742	5405.	18.175	203.856	.11774	3836.	1000.	5000.	11.075	2201.
27	8	.591	.878	5149.	1550.	1.730	5377.	16.757	207.733	.11960	3848.	1000.	5000.	12.225	2453.
28	8	.644	.944	5170.	1467.	1.729	5374.	15.844	208.133	.11979	3849.	1000.	5000.	13.485	2729.
29	8	.696	1.000	5197.	1421.	1.735	5388.	15.296	206.242	.11888	3843.	1000.	5000.	14.795	3016.
30	8	.748	1.070	5228.	1401.	1.745	5412.	15.001	202.884	.11727	3833.	1000.	5000.	16.126	3307.
31	8	.797	1.129	5261.	1398.	1.758	5444.	14.886	198.615	.11521	3819.	1000.	5000.	17.458	3600.
32	8	.846	1.185	5295.	1409.	1.773	5479.	14.898	193.816	.11289	3804.	1000.	5000.	18.775	3890.
33	8	.892	1.239	5338.	1428.	1.790	5518.	15.000	186.755	.11042	3787.	1000.	5000.	20.065	4175.
33		F X =	4176.1	FID =		4265.5	ETAF = .9795		ISP =	208.089	ISPID =		210.315	ETAI =	.9894
11	9	.351	.472	3882.	157.	1.169	3885.	2.323	463.470	.23345	4399.	1000.	5000.	3.900	747.
12	9	.380	.491	4032.	246.	1.223	4040.	3.495	433.408	.22075	4350.	1000.	5000.	4.766	915.
13	9	.405	.524	4163.	337.	1.271	4176.	4.629	407.416	.20966	4305.	1000.	5000.	5.456	1051.
14	9	.424	.528	4279.	430.	1.315	4301.	5.738	384.088	.19960	4263.	1000.	5000.	6.040	1167.
15	9	.442	.585	4386.	525.	1.357	4417.	6.828	362.727	.19031	4222.	1000.	5000.	6.554	1270.
16	9	.460	.609	4485.	623.	1.397	4528.	7.903	342.927	.18161	4183.	1000.	5000.	7.015	1364.
17	9	.476	.630	4576.	722.	1.437	4633.	8.967	324.424	.17341	4145.	1000.	5000.	7.437	1450.
18	9	.491	.651	4662.	824.	1.475	4735.	10.020	307.035	.16563	4107.	1000.	5000.	7.827	1531.
19	9	.506	.670	4743.	928.	1.512	4833.	11.065	290.629	.15822	4069.	1000.	5000.	8.191	1607.
20	9	.521	.689	4818.	1033.	1.549	4928.	12.102	275.102	.15114	4032.	1000.	5000.	8.535	1679.
21	9	.535	.707	4890.	1141.	1.586	5021.	13.132	260.376	.14437	3995.	1000.	5000.	8.859	1748.
22	9	.548	.724	4956.	1250.	1.622	5112.	14.156	246.388	.13788	3959.	1000.	5000.	9.168	1815.
23	9	.561	.742	5019.	1361.	1.657	5200.	15.174	233.083	.13165	3922.	1000.	5000.	9.464	1878.
24	9	.575	.759	5078.	1474.	1.693	5287.	16.186	220.419	.12566	3886.	1000.	5000.	9.747	1940.
25	9	.588	.775	5133.	1588.	1.728	5373.	17.194	208.357	.11990	3850.	1000.	5000.	10.018	1999.
26	9	.603	.792	5184.	1704.	1.764	5457.	18.198	196.865	.11436	3814.	1000.	5000.	10.281	2056.
27	9	.651	.858	5195.	1561.	1.758	5425.	16.728	201.18[illegible]	.11645	3827.	1000.	5000.	11.348	2291.
28	9	.704	.903	5215.	1473.	1.748	5419.	15.777	201.941	.11682	3830.	1000.	5000.	12.533	2552.
29	9	.757	.987	5241.	1424.	1.753	5431.	15.200	200.[illegible]33	.11604	3825.	1000.	5000.	13.776	2825.
30	9	.809	1.048	5271.	1401.	1.765	5454.	14.883	197.210	.11453	3815.	1000.	5000.	15.048	3105.
31	9	.859	1.107	5304.	1396.	1.776	5484.	14.751	193.143	.11256	3801.	1000.	5000.	16.328	3387.
32	9	.908	1.163	5337.	1405.	1.791	5510.	14.750	188.520	.11031	3786.	1000.	5000.	17.599	3667.
33	9	.956	1.217	5372.	1425.	1.807	5557.	14.842	183.615	.10791	3770.	1000.	5000.	18.848	3944.
34	9	1.001	1.268	5415.	1448.	1.824	5596.	15.000	178.617	.10546	3752.	1000.	5000.	20.064	4214.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	WDOT	F
34		F =	4215.1	FID =		4301.0	ETAF =	.9800	ISP =	210.051	ISPID =		212.166	ETAI =	.9859
11	10	.381	.297	3912.	158.	1.180	3915.	2.309	457.627	.23096	4389.	1000.	5000.	3.130	680.
12	10	.413	.453	4065.	248.	1.239	4073.	3.488	427.107	.21807	4339.	1000.	5008.	3.972	764.
13	10	.439	.484	4198.	347.	1.283	4211.	4.675	400.797	.20682	4293.	1000.	5000.	4.652	898.
14	10	.462	.522	4316.	434.	1.328	4338.	[illegible]	377.234	.19653	4250.	1000.	5008.	5.234	1014.
15	10	.483	.551	4425.	530.	1.371	4456.	6.827	355.701	.18723	4209.	1000.	5000.	5.749	1118.
16	10	.502	.576	4525.	628.	1.412	4568.	7.905	335.777	.17845	4168.	1000.	5000.	6.215	1213.
17	10	.520	.600	4616.	729.	1.452	4675.	8.966	317.190	.17018	4129.	1000.	5000.	6.643	1381.
18	10	.537	.622	4705.	831.	1.491	4778.	10.018	299.751	.16235	4090.	1000.	5000.	7.040	1383.
19	10	.555	.643	4787.	936.	1.529	4877.	11.061	283.322	.15490	4052.	1000.	5008.	7.413	1461.
20	10	.569	.663	4863.	1042.	1.567	4974.	12.096	267.799	.14779	4014.	1000.	5000.	7.765	1536.
21	10	.583	.683	4935.	1151.	1.604	5069.	13.125	253.098	.14100	3977.	1000.	5000.	8.099	1607.
22	10	.603	.702	5003.	1261.	1.641	5159.	14.144	239.155	.13450	3939.	1000.	5000.	8.417	1675.
23	10	.614	.721	5067.	1373.	1.677	5249.	15.159	225.913	.12826	3902.	1000.	5000.	8.722	1741.
24	10	.629	.739	5126.	1486.	1.714	5337.	16.168	215.327	.12228	3865.	1000.	5000.	9.015	1805.
25	10	.645	.757	5182.	1601.	1.750	5423.	17.172	201.357	.11653	3828.	1000.	5000.	9.298	1867.
26	10	.658	.776	5234.	1718.	1.786	5508.	18.172	189.969	.11101	3791.	1000.	5000.	9.570	1927.
27	10	.704	.839	5243.	1569.	1.771	5473.	16.655	194.705	.11332	3807.	1000.	5000.	10.562	2146.
28	10	.761	.904	5262.	1476.	1.767	5465.	15.667	195.795	.11384	3810.	1000.	5000.	11.677	2392.
29	10	.814	.967	5286.	1423.	1.771	5474.	15.064	194.461	.11320	3806.	1000.	5000.	12.857	2652.
30	10	.867	1.028	5316.	1397.	1.787	5496.	14.726	191.570	.11179	3796.	1000.	5000.	14.073	2920.
31	10	.918	1.086	5348.	1391.	1.793	5526.	14.580	187.702	.10991	3783.	1000.	5000.	15.305	3192.
32	10	.968	1.142	5381.	1398.	1.803	5560.	14.568	183.256	.10773	3768.	1000.	5000.	16.529	3464.
33	10	1.017	1.196	5415.	1416.	1.824	5597.	14.651	178.509	.10541	3752.	1000.	5000.	17.739	3732.
34	10	1.063	1.248	5444.	1440.	1.841	5635.	14.802	173.654	.10301	3735.	1000.	5000.	18.919	3995.
35	10	1.108	1.297	5441.	1469.	1.858	5674.	15.000	168.823	.10062	3717.	1000.	5000.	20.063	4251.
35		F =	4251.7	FID =		4335.3	ETAF =	.9807	ISP =	211.854	ISPID =		213.861	ETAI =	.9906
11	11	.410	.156	3946.	156.	1.191	3948.	2.262	451.304	.22832	4379.	1000.	5000.	2.509	482.
12	11	.443	.412	4130.	247.	1.246	4138.	3.446	420.431	.21322	4328.	1000.	5000.	3.319	639.
13	11	.473	.454	4235.	340.	1.296	4248.	4.567	393.879	.20384	4281.	1000.	5000.	3.976	770.
14	11	.499	.489	4355.	422.	1.342	4377.	5.699	370.147	.19355	4237.	1000.	5000.	4.548	884.
15	11	.521	.519	4465.	532.	1.386	4496.	6.791	348.497	.18407	4194.	1000.	5000.	5.059	987.
16	11	.541	.547	4566.	631.	1.428	4610.	7.866	328.499	.17522	4153.	1000.	5000.	5.523	1082.
17	11	.561	.572	4661.	732.	1.468	4718.	8.928	309.873	.16690	4113.	1000.	5000.	5.952	1170.
18	11	.582	.595	4749.	836.	1.506	4822.	9.979	292.424	.15903	4074.	1000.	5000.	6.353	1254.
19	11	.598	.618	4832.	941.	1.547	4922.	11.020	276.011	.15156	4035.	1000.	5000.	6.729	1335.
20	11	.615	.643	4909.	1048.	1.585	5028.	12.052	260.525	.14444	3996.	1000.	5000.	7.086	1409.
21	11	.632	.660	4982.	1157.	1.623	5115.	13.077	245.882	.13764	3958.	1000.	5000.	7.426	1481.
22	11	.648	.681	5051.	1268.	1.660	5207.	14.095	232.013	.13114	3919.	1000.	5000.	7.751	1551.
23	11	.665	.701	5115.	1381.	1.698	5298.	15.106	218.861	.12492	3881.	1000.	5000.	8.063	1619.
24	11	.682	.721	5175.	1495.	1.734	5387.	16.111	206.379	.11895	3844.	1000.	5000.	8.363	1684.
25	11	.696	.741	5232.	1611.	1.771	5474.	17.111	194.525	.11323	3806.	1000.	5000.	8.653	1748.
26	11	.712	.762	5284.	1729.	1.808	5560.	18.107	183.263	.10774	3768.	1000.	5000.	8.934	1810.
27	11	.742	.822	5292.	1572.	1.791	5520.	16.547	188.377	.11024	3786.	1000.	5000.	9.876	2014.
28	11	.815	.886	5329.	1475.	1.786	5510.	15.526	189.783	.11092	3790.	1000.	5000.	10.906	2247.
29	11	.868	.948	5332.	1419.	1.790	5518.	14.898	188.712	.11040	3787.	1000.	5000.	12.027	2495.
30	11	.922	1.008	5361.	1391.	1.799	5538.	14.544	186.045	.10910	3778.	1000.	5000.	13.190	2752.
31	11	.974	1.067	5392.	1383.	1.811	5567.	14.383	182.373	.10730	3765.	1000.	5000.	14.372	3014.
32	11	1.025	1.123	5425.	1389.	1.825	5600.	14.360	178.101	.10520	3750.	1000.	5000.	15.556	3277.
33	11	1.075	1.177	5458.	1405.	1.841	5636.	14.435	173.510	.10294	3734.	1000.	5000.	16.727	3538.
34	11	1.122	1.228	5491.	1428.	1.858	5674.	14.580	168.798	.10060	3717.	1000.	5000.	17.874	3794.
35	11	1.168	1.278	5524.	1457.	1.875	5713.	14.773	164.096	.09826	3700.	1000.	5000.	18.987	4043.
36	11	1.212	1.324	5555.	1488.	1.892	5751.	15.000	159.490	.09596	3682.	1000.	5000.	20.062	4285.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
36		F =	4286.0	FID =		4367.0	ETAF = .9815		ISP = 213.562		ISPID = 215.421			ETAI = .9914	
11	12	.434	.324	3978.	152.	1.202	3981.	2.191	444.821	.22558	4369.	1000.	5000.	2.012	387.
12	12	.473	.374	4136.	244.	1.259	4143.	3.381	413.666	.21233	4316.	1000.	5000.	2.774	536.
13	12	.504	.422	4272.	339.	1.309	4286.	4.524	386.952	.20084	4268.	1000.	5000.	3.411	662.
14	12	.531	.459	4394.	435.	1.356	4415.	5.637	363.079	.19046	4223.	1000.	5000.	3.969	774.
15	12	.555	.491	4505.	532.	1.401	4536.	6.729	341.356	.18092	4180.	1000.	5000.	4.471	875.
16	12	.578	.523	4608.	631.	1.443	4651.	7.809	321.322	.17203	4138.	1000.	5000.	4.930	969.
17	12	.599	.546	4703.	734.	1.485	4760.	8.864	302.691	.16367	4097.	1000.	5000.	5.357	1058.
18	12	.619	.571	4793.	835.	1.525	4865.	9.913	285.263	.15578	4057.	1000.	5000.	5.757	1141.
19	12	.639	.595	4876.	944.	1.564	4967.	10.952	268.894	.14830	4017.	1000.	5000.	6.134	1221.
20	12	.658	.618	4955.	1051.	1.603	5065.	11.981	253.471	.14117	3978.	1000.	5000.	6.493	1297.
21	12	.676	.640	5029.	1161.	1.642	5161.	13.003	238.909	.13438	3939.	1000.	5000.	6.836	1370.
22	12	.694	.662	5098.	1273.	1.680	5255.	14.017	225.135	.12789	3900.	1000.	5000.	7.165	1442.
23	12	.711	.683	5163.	1386.	1.717	5346.	15.025	212.092	.12169	3861.	1000.	5000.	7.481	1510.
24	12	.729	.704	5224.	1501.	1.755	5435.	16.027	199.730	.11575	3823.	1000.	5000.	7.786	1577.
25	12	.746	.726	5281.	1617.	1.792	5523.	17.023	188.007	.11006	3784.	1000.	5003.	8.081	1642.
26	12	.763	.746	5335.	1722.	1.829	5609.	18.014	176.885	.10461	3746.	1000.	5000.	8.367	1706.
27	12	.813	.827	5342.	1573.	1.811	5567.	16.414	182.341	.10729	3765.	1000.	5000.	9.227	1897.
28	12	.865	.893	5355.	1471.	1.805	5551.	15.363	184.038	.10812	3772.	1000.	5000.	10.218	2117.
29	12	.919	.935	5378.	1412.	1.808	5560.	14.715	183.213	.10771	3768.	1000.	5000.	11.285	2353.
30	12	.974	.992	5435.	1382.	1.816	5579.	14.342	180.758	.10651	3760.	1000.	5000.	12.398	2600.
31	12	1.027	1.048	5436.	1372.	1.828	5606.	14.170	177.273	.10480	3748.	1000.	5000.	13.556	2853.
32	12	1.079	1.105	5468.	1377.	1.842	5639.	14.138	173.167	.10277	3733.	1000.	5000.	14.680	3108.
33	12	1.129	1.159	5531.	1395.	1.858	5675.	14.206	166.728	.10057	3717.	1000.	5000.	15.815	3362.
34	12	1.178	1.212	5534.	1415.	1.875	5712.	14.346	164.153	.09829	3700.	1000.	5000.	16.929	3611.
35	12	1.225	1.260	5566.	1443.	1.892	5750.	14.535	159.578	.09600	3682.	1000.	5000.	18.013	3854.
36	12	1.270	1.307	5597.	1474.	1.909	5788.	14.758	155.088	.09375	3665.	1000.	5000.	19.062	4051.
37	12	1.312	1.351	5627.	1504.	1.925	5825.	15.000	150.793	.09158	3648.	1000.	5000.	20.062	4316.
37		F =	4317.7	FID =		4395.8	ETAF = .9822		ISP = 215.142		ISPID = 216.846			ETAI = .9921	
11	13	.461	.286	4015.	147.	1.214	4016.	2.096	438.047	.22272	4357.	1000.	5000.	1.602	309.
12	13	.501	.347	4173.	240.	1.272	4180.	3.291	406.672	.20974	4304.	1000.	5000.	2.315	449.
13	13	.534	.393	4311.	334.	1.323	4324.	4.436	379.803	.19775	4255.	1000.	5000.	2.924	569.
14	13	.563	.431	4434.	431.	1.371	4455.	5.550	355.872	.18731	4209.	1000.	5000.	3.463	677.
15	13	.589	.464	4547.	529.	1.416	4578.	6.642	334.112	.17771	4165.	1000.	5000.	3.953	777.
16	13	.613	.494	4651.	631.	1.459	4693.	7.715	314.076	.16875	4122.	1000.	5000.	4.404	869.
17	13	.636	.522	4747.	733.	1.501	4803.	8.774	295.470	.16041	4081.	1000.	5000.	4.825	957.
18	13	.658	.548	4838.	837.	1.542	4909.	9.821	278.092	.15251	4040.	1000.	5000.	5.222	1040.
19	13	.678	.573	4922.	944.	1.582	5012.	10.857	261.792	.14503	3999.	1000.	5000.	5.599	1119.
20	13	.699	.598	5002.	1052.	1.621	5111.	11.884	246.457	.13791	3959.	1000.	5000.	5.957	1196.
21	13	.718	.621	5076.	1163.	1.660	5208.	12.902	231.997	.13113	3919.	1000.	5000.	6.301	1270.
22	13	.738	.644	5146.	1275.	1.699	5302.	13.913	218.340	.12467	3880.	1000.	5000.	6.632	1341.
23	13	.757	.666	5212.	1389.	1.737	5394.	14.918	205.424	.11849	3841.	1000.	5000.	6.950	1411.
24	13	.775	.689	5274.	1504.	1.775	5484.	15.916	193.200	.11259	3802.	1000.	5000.	7.259	1479.
25	13	.794	.711	5331.	1621.	1.813	5572.	16.908	181.623	.10694	3763.	1000.	5000.	7.557	1545.
26	13	.812	.733	5385.	1739.	1.851	5659.	17.895	170.655	.10153	3724.	1000.	5000.	7.847	1609.
27	13	.861	.792	5389.	1571.	1.851	5613.	16.257	176.426	.10438	3745.	1000.	5000.	8.648	1788.
28	13	.914	.853	5402.	1462.	1.824	5598.	15.177	178.398	.10535	3751.	1000.	5000.	9.583	1996.
29	13	.969	.913	5424.	1403.	1.826	5602.	14.506	177.810	.10506	3749.	1000.	5000.	10.598	2222.
30	13	1.024	.973	5458.	1371.	1.834	5670.	14.121	175.561	.10395	3741.	1000.	5000.	11.665	2459.
31	13	1.078	1.031	5488.	1360.	1.846	5696.	13.937	172.259	.10232	3730.	1000.	5000.	12.760	2704.
32	13	1.131	1.087	5512.	1364.	1.860	5678.	13.897	168.319	.10037	3715.	1000.	5000.	13.865	2950.
33	13	1.182	1.141	5545.	1378.	1.875	5713.	13.959	164.029	.09823	3699.	1000.	5000.	14.964	3197.
34	13	1.232	1.193	5577.	1400.	1.892	5750.	14.094	159.591	.09601	3682.	1000.	5000.	16.047	3439.
35	13	1.282	1.242	5609.	1428.	1.908	5788.	14.279	155.142	.09377	3665.	1000.	5000.	17.102	3677.

I	J	X	Y	U	V	M	TMAS	THETA	P	RHO	T	PT	TT	[illegible]	F
36	13	1.326	1.298	5638.	1437.	1.925	5826.	14.588	150.767	.09557	3648.	1000.	5000.	18.125	3980.
37	13	1.378	1.338	5669.	1492.	1.942	5862.	14.748	146.878	.08944	3631.	1000.	5000.	19.182	4123.
38	13	1.412	1.378	5698.	1527.	1.959	5899.	15.000	142.464	.08734	3613.	1000.	5000.	20.061	4347.

38 F = 4348.8 FID = 4625.2 ETAP = .9836 ISP = 216.651 ISPID = 216.194 ETAI = .9929

I	J	X	Y	U	V	M	TMAS	THETA	P	RHO	T	PT	TT	[illegible]	F
11	14	.485	.255	4049.	148.	1.227	4052.	1.981	431.167	.21979	4346.	1000.	5000.	1.266	240.
12	14	.527	.317	4211.	234.	1.285	4218.	3.183	399.689	.20638	4291.	1000.	5000.	1.927	374.
13	14	.562	.365	4351.	329.	1.337	4363.	4.338	372.648	.19463	4241.	1000.	5000.	2.585	487.
14	14	.593	.405	4475.	427.	1.386	4495.	5.444	348.662	.18414	4195.	1000.	5000.	3.025	593.
15	14	.621	.438	4589.	526.	1.431	4619.	6.535	326.895	.17451	4150.	1000.	5000.	3.498	690.
16	14	.647	.471	4694.	627.	1.475	4735.	7.607	306.882	.16556	4106.	1000.	5000.	3.939	788.
17	14	.671	.500	4791.	730.	1.518	4847.	8.664	2[illegible].326	.15717	4064.	1000.	5000.	4.353	866.
18	14	.694	.527	4883.	835.	1.559	4953.	9.709	2[illegible].819	.14927	4022.	1000.	5000.	4.744	949.
19	14	.716	.553	4964.	942.	1.600	5057.	10.742	254.809	.14179	3981.	1000.	5000.	5.117	1028.
20	14	.738	.578	5048.	1052.	1.640	5157.	11.766	239.580	.13470	3940.	1000.	5000.	5.474	1104.
21	14	.759	.603	5124.	1162.	1.679	5254.	12.781	225.235	.12794	3900.	1000.	5000.	5.817	1178.
22	14	.780	.627	5194.	1275.	1.718	5349.	13.789	211.712	.12151	3860.	1000.	5000.	6.148	1250.
23	14	.800	.651	5261.	1389.	1.757	5441.	14.790	198.938	.11537	3820.	1000.	5000.	6.467	1320.
24	14	.820	.674	5323.	1505.	1.796	5532.	15.784	186.863	.10950	3781.	1000.	5000.	6.777	1388.
25	14	.840	.697	5382.	1622.	1.834	5621.	16.773	175.444	.10389	3741.	1000.	5000.	7.078	1455.
26	14	.869	.721	5436.	1741.	1.873	5738.	17.756	164.639	.09854	3702.	1000.	5000.	7.370	1521.
27	14	.918	.778	5437.	1568.	1.851	5659.	16.082	170.699	.10155	3724.	1000.	5000.	8.117	1688.
28	14	.962	.837	5449.	1458.	1.863	5641.	14.975	172.930	.10265	3732.	1000.	5000.	9.000	1885.
29	14	1.017	.897	5469.	1395.	1.855	5644.	14.284	172.566	.10247	3731.	1000.	5000.	9.967	2100.
30	14	1.072	.957	5495.	1358.	1.852	5660.	13.884	170.516	.10146	3725.	1000.	5000.	10.989	2329.
31	14	1.127	1.014	5524.	1346.	1.863	5686.	13.690	167.391	.09991	3712.	1000.	5000.	12.043	2564.
32	14	1.181	1.073	5555.	1348.	1.877	5717.	13.643	163.611	.09802	3698.	1000.	5000.	13.110	2803.
33	14	1.234	1.124	5588.	1362.	1.892	5751.	13.699	159.467	.09595	3682.	1000.	5000.	14.176	3042.
34	14	1.285	1.176	5620.	1384.	1.908	5786.	13.830	155.163	.09379	3665.	1000.	5000.	15.227	3279.
35	14	1.336	1.226	5652.	1410.	1.925	5825.	14.015	150.837	.09160	3648.	1000.	5000.	16.254	3511.
36	14	1.381	1.273	5682.	1441.	1.942	5862.	14.231	146.576	.08944	3631.	1000.	5000.	17.252	3737.
37	14	1.435	1.318	5712.	1474.	1.959	5890.	14.469	142.491	.08736	3614.	1000.	5000.	18.206	3953.
38	14	1.469	1.362	5740.	1509.	1.976	5935.	14.728	138.476	.08530	3596.	1000.	5000.	19.145	4166.
39	14	1.511	1.405	5768.	1545.	1.992	5971.	15.000	134.581	.08330	3579.	1000.	5000.	20.061	4375.

39 F = 4376.7 FID = 4443.9 ETAP = .9838 ISP = 218.084 ISPID = 219.465 ETAI = .9937

I	J	X	Y	U	V	M	TMAS	THETA	P	RHO	T	PT	TT	[illegible]	F
11	15	.527	.226	4086.	132.	1.246	4088.	1.849	424.167	.21682	4334.	1000.	5000.	.986	191.
12	15	.562	.292	4258.	227.	1.299	4256.	3.057	392.450	.20322	4278.	1000.	5000.	1.594	310.
13	15	.593	.337	4391.	323.	1.352	4403.	4.206	365.407	.19148	4228.	1000.	5000.	2.138	417.
14	15	.622	.380	4517.	421.	1.401	4536.	5.321	341.407	.18094	4180.	1000.	5000.	2.633	518.
15	15	.652	.415	4632.	520.	1.447	4661.	6.411	319.656	.17128	4134.	1000.	5000.	3.092	612.
16	15	.679	.448	4738.	622.	1.491	4778.	7.481	299.689	.16232	4090.	1000.	5000.	3.520	700.
17	15	.705	.478	4836.	724.	1.534	4890.	8.536	281.203	.15395	4047.	1000.	5000.	3.925	785.
18	15	.730	.506	4928.	832.	1.577	4998.	9.578	263.987	.14604	4005.	1000.	5000.	4.310	866.
19	15	.753	.535	5014.	939.	1.618	5102.	10.609	247.884	.13858	3963.	1000.	5000.	4.678	944.
20	15	.777	.560	5095.	1049.	1.658	5202.	11.630	232.777	.13150	3922.	1000.	5000.	5.032	1020.
21	15	.799	.585	5172.	1160.	1.698	5300.	12.642	218.570	.12478	3881.	1000.	5000.	5.372	1093.
22	15	.821	.611	5243.	1273.	1.738	5396.	13.647	205.188	.11838	3840.	1000.	5000.	5.702	1165.
23	15	.843	.635	5310.	1388.	1.777	5489.	14.644	192.568	.11228	3800.	1000.	5000.	6.021	1236.
24	15	.864	.660	5373.	1504.	1.817	5580.	15.635	180.655	.10646	3759.	1000.	5000.	6.331	1304.
25	15	.885	.685	5432.	1621.	1.856	5669.	16.619	169.404	.10091	3719.	1000.	5000.	6.633	1371.
26	15	.904	.709	5488.	1741.	1.895	5757.	17.598	158.772	.09560	3679.	1000.	5000.	6.926	1437.
27	15	.958	.764	5486.	1562.	1.872	5704.	15.899	165.099	.09876	3705.	1000.	5000.	7.621	1593.
28	15	1.008	.823	5497.	1448.	1.862	5684.	14.756	167.575	.10000	3713.	1000.	5000.	8.455	1780.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
29	15	1.063	.882	5515.	1380.	1.863	5685.	14.047	167.427	.09992	3712.	1000.	5000.	9.376	1986.
30	15	1.119	.940	5540.	1344.	1.869	5701.	13.634	165.569	.09900	3705.	1000.	5000.	10.355	2205.
31	15	1.175	.998	5568.	1330.	1.880	5725.	13.430	162.618	.09753	3694.	1000.	5000.	11.369	2432.
32	15	1.230	1.054	5599.	1331.	1.894	5755.	13.375	158.995	.09571	3680.	1000.	5000.	12.400	2664.
33	15	1.284	1.108	5631.	1344.	1.909	5789.	13.427	154.995	.09370	3665.	1000.	5000.	13.433	2896.
34	15	1.336	1.160	5663.	1365.	1.925	5825.	13.554	150.823	.09159	3648.	1000.	5000.	14.454	3127.
35	15	1.386	1.209	5694.	1392.	1.942	5862.	13.735	146.618	.08946	3631.	1000.	5000.	15.454	3353.
36	15	1.435	1.257	5725.	1422.	1.959	5899.	13.951	142.470	.08735	3613.	1000.	5000.	16.427	3574.
37	15	1.480	1.302	5754.	1455.	1.976	5935.	14.188	138.489	.08531	3596.	1000.	5000.	17.358	3785.
38	15	1.525	1.346	5782.	1490.	1.992	5971.	14.446	134.571	.08329	3579.	1000.	5000.	18.276	3995.
39	15	1.568	1.389	5810.	1526.	2.009	6007.	14.717	130.769	.08133	3562.	1000.	5000.	19.173	4199.
40	15	1.611	1.431	5837.	1564.	2.026	6042.	15.000	127.047	.07939	3545.	1000.	5000.	20.060	4403.
40		F =	4404.4	FID =		4473.7	ETAF = .9845		ISP =	219.463	ISPID =		220.684	ETAI =	.9945
11	16	.529	.198	4124.	122.	1.253	4126.	1.699	416.955	.21374	4322.	1000.	5000.	.751	146.
12	16	.577	.263	4290.	218.	1.313	4295.	2.915	385.085	.20004	4265.	1000.	5000.	1.303	254.
13	16	.617	.313	4432.	315.	1.367	4444.	4.065	357.987	.18824	4213.	1000.	5000.	1.811	356.
14	16	.651	.355	4560.	413.	1.416	4578.	5.180	333.984	.17766	4165.	1000.	5000.	2.281	450.
15	16	.683	.392	4676.	514.	1.463	4704.	6.268	312.270	.16798	4118.	1000.	5000.	2.721	540.
16	16	.712	.426	4783.	616.	1.508	4822.	7.337	292.370	.15901	4073.	1000.	5000.	3.135	626.
17	16	.739	.457	4882.	720.	1.552	4935.	8.390	273.974	.15063	4030.	1000.	5000.	3.530	708.
18	16	.765	.436	4975.	826.	1.595	5043.	9.429	256.868	.14275	3986.	1000.	5000.	3.906	788.
19	16	.790	.515	5062.	934.	1.636	5148.	10.457	240.891	.13531	3944.	1000.	5000.	4.268	865.
20	16	.815	.542	5144.	1044.	1.677	5249.	11.475	225.923	.12827	3902.	1000.	5000.	4.617	940.
21	16	.839	.568	5221.	1156.	1.718	5347.	12.484	211.867	.12158	3861.	1000.	5000.	4.954	1013.
22	16	.862	.594	5293.	1269.	1.756	5443.	13.485	198.646	.11522	3819.	1000.	5000.	5.281	1085.
23	16	.885	.620	5361.	1384.	1.798	5537.	14.478	186.194	.10917	3778.	1000.	5000.	5.598	1155.
24	16	.908	.646	5425.	1501.	1.838	5629.	15.465	174.456	.10341	3738.	1000.	5000.	5.907	1224.
25	16	.931	.672	5485.	1619.	1.877	5719.	16.446	163.385	.09791	3697.	1000.	5000.	6.209	1291.
26	16	.953	.697	5540.	1738.	1.917	5807.	17.421	152.9[illegible]	.09266	3656.	1000.	5000.	6.503	1357.
27	16	1.001	.750	5537.	1554.	1.892	5751.	15.677	159.517	.09597	3682.	1000.	5000.	7.149	1503.
28	16	1.056	.808	5545.	1436.	1.882	5728.	14.518	162.229	.09733	3693.	1000.	5000.	7.935	1679.
29	16	1.110	.866	5563.	1365.	1.881	5726.	13.790	162.293	.09736	3693.	1000.	5000.	8.810	1876.
30	16	1.167	.924	5586.	1327.	1.888	57[illegible]2.	13.364	160.626	.09653	3686.	1000.	5000.	9.747	2086.
31	16	1.224	.981	5614.	1312.	1.898	5765.	13.151	157.846	.09514	3676.	1000.	5000.	10.723	2305.
32	16	1.280	1.037	5644.	1312.	1.911	5794.	13.090	154.381	.09339	3662.	1000.	5000.	11.718	2529.
33	16	1.335	1.091	5675.	1325.	1.926	5828.	13.138	150.525	.09144	3647.	1000.	5000.	12.717	2755.
34	16	1.388	1.143	5707.	1345.	1.942	5863.	13.262	146.486	.08939	3630.	1000.	5000.	13.708	2979.
35	16	1.439	1.193	5738.	1371.	1.959	5899.	13.440	142.404	.08731	3613.	1000.	5000.	14.680	3199.
36	16	1.489	1.241	5768.	1401.	1.976	5936.	13.655	138.370	.08525	3596.	1000.	5000.	15.628	3415.
37	16	1.535	1.286	5797.	1434.	1.993	5972.	13.890	134.492	.08325	3579.	1000.	5000.	16.537	3622.
38	16	1.581	1.331	5826.	1468.	2.009	6008.	14.148	130.674	.08128	3562.	1000.	5000.	17.433	3827.
39	16	1.626	1.374	5853.	1505.	2.026	6043.	14.418	126.966	.07935	3545.	1000.	5000.	18.311	4028.
40	16	1.670	1.416	5880.	1543.	2.043	6079.	14.701	123.333	.07745	3528.	1000.	5000.	19.180	4227.
41	16	1.714	1.459	5906.	1583.	2.060	6115.	15.000	119.707	.07555	3510.	1000.	5000.	20.060	4430.
41		F =	4431.7	FID =		4497.9	ETAF = .9853		ISP =	220.820	ISPID =		221.882	ETAI =	.9952
11	17	.552	.169	4165.	111.	1.267	4166.	1.524	409.264	.21045	4308.	1000.	5000.	.547	106.
12	17	.603	.236	4333.	208.	1.328	4338.	2.749	377.232	.19663	4250.	1000.	5000.	1.040	204.
13	17	.645	.287	4477.	305.	1.383	4487.	3.901	350.090	.18477	4198.	1000.	5000.	1.508	297.
14	17	.681	.331	4606.	404.	1.433	4623.	5.015	326.105	.17416	4148.	1000.	5000.	1.950	387.
15	17	.714	.369	4723.	505.	1.481	4750.	6.102	304.450	.16447	4101.	1000.	5000.	2.369	472.
16	17	.745	.403	4831.	608.	1.526	4869.	7.169	284.640	.15550	4055.	1000.	5000.	2.767	555.
17	17	.774	.435	4932.	712.	1.571	4983.	8.219	266.359	.14713	4011.	1000.	5000.	3.149	635.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	[illegible]	[illegible]
18	17	.802	.466	5026.	819.	1.614	5092.	9.235	249.385	.13827	3967.	1000.	5000.	3.516	[illegible]
19	17	.829	.495	5114.	927.	1.656	5197.	10.280	233.557	.13187	3924.	1000.	5000.	3.869	[illegible]
20	17	.855	.523	5196.	1038.	1.698	5299.	11.294	216.752	.12486	3881.	1000.	5000.	4.211	[illegible]
21	17	.880	.551	5274.	1150.	1.739	5398.	12.299	204.078	.11823	3839.	1000.	5000.	4.544	935.
22	17	.905	.578	5347.	1264.	1.780	5494.	13.296	191.651	.11192	3797.	1000.	5000.	4.867	1006.
23	17	.930	.605	5416.	1379.	1.820	5588.	14.286	179.569	.10593	3756.	1000.	5000.	5.182	1075.
24	17	.954	.632	5480.	1496.	1.861	5684.	15.269	168.027	.10022	3714.	1000.	5000.	5.489	1194.
25	17	.978	.658	5540.	1614.	1.901	5771.	16.245	157.156	.09479	3673.	1000.	5000.	5.789	[illegible]
26	17	1.002	.685	5597.	1734.	1.941	5859.	17.216	146.913	.08961	3632.	1000.	5000.	6.085	1278.
27	17	1.049	.736	5591.	1544.	1.914	5800.	15.437	153.737	.09307	3668.	1000.	5000.	6.680	1412.
28	17	1.102	.793	5597.	1422.	1.903	5775.	14.251	156.686	.09455	3671.	1000.	5000.	7.417	1579.
29	17	1.159	.850	5613.	1348.	1.901	5772.	13.504	156.965	.09469	3672.	1000.	5000.	8.247	1765.
30	17	1.216	.908	5635.	1308.	1.907	5785.	13.064	155.493	.09395	3667.	1000.	5000.	9.141	1967.
31	17	1.274	.964	5662.	1291.	1.917	5807.	12.842	152.892	.09264	3656.	1000.	5000.	10.076	2177.
32	17	1.331	1.020	5691.	1290.	1.930	5836.	12.775	149.590	.09097	3643.	1000.	5000.	11.034	2394.
33	17	1.387	1.074	5722.	1302.	1.945	5868.	12.818	145.885	.08909	3628.	1000.	5000.	12.000	2622.
34	17	1.442	1.126	5753.	1322.	1.961	5903.	12.939	141.984	.08710	3611.	1000.	5000.	12.959	2830.
35	17	1.495	1.176	5784.	1348.	1.977	5939.	13.115	138.030	.08507	3594.	1000.	5000.	13.902	3044.
36	17	1.545	1.224	5814.	1378.	1.994	5975.	13.329	134.115	.08306	3577.	1000.	5000.	14.824	3254.
37	17	1.593	1.269	5843.	1410.	2.011	6011.	13.564	130.347	.08111	3560.	1000.	5000.	15.709	3456.
38	17	1.640	1.314	5871.	1444.	2.028	6046.	13.821	126.632	.07918	3543.	1000.	5000.	16.583	3657.
39	17	1.686	1.357	5899.	1481.	2.044	6082.	14.091	123.022	.07729	3526.	1000.	5000.	17.440	3853.
40	17	1.732	1.400	5925.	1519.	2.061	6117.	14.374	119.483	.07543	3509.	1000.	5000.	18.289	4049.
41	17	1.777	1.443	5952.	1559.	2.079	6153.	14.673	115.951	.07357	3492.	1000.	5000.	19.150	4248.
42	17	1.825	1.469	5980.	1602.	2.097	6191.	15.000	112.289	.07163	3475.	1000.	5000.	20.059	4458.

42 F = 4459.6 FID = 4522.8 ETAF = .9860 ISP = 222.211 ISPID = 223.109 ETAI = .9960

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	[illegible]	[illegible]
11	18	.577	.139	4212.	96.	1.283	4213.	1.309	400.551	.20671	4293.	1000.	5000.	.365	71.
12	18	.631	.207	4382.	195.	1.346	4387.	2.546	368.316	.19275	4235.	1000.	5000.	.790	155.
13	18	.676	.259	4528.	293.	1.401	4538.	3.699	341.138	.18082	4180.	1000.	5000.	1.214	240.
14	18	.714	.304	4659.	392.	1.452	4675.	4.812	317.192	.17018	4129.	1000.	5000.	1.623	323.
15	18	.750	.343	4777.	493.	1.501	4803.	5.896	295.626	.16048	4081.	1000.	5000.	2.016	404.
16	18	.782	.378	4887.	597.	1.547	4923.	6.960	275.938	.15153	4034.	1000.	5000.	2.395	483.
17	18	.813	.412	4988.	702.	1.592	5037.	8.007	257.806	.14318	3989.	1000.	5000.	2.760	560.
18	18	.843	.443	5083.	809.	1.636	5147.	9.040	241.003	.13536	3944.	1000.	5000.	3.114	635.
19	18	.871	.473	5172.	918.	1.679	5253.	10.060	225.363	.12800	3900.	1000.	5000.	3.458	708.
20	18	.899	.503	5256.	1028.	1.721	5355.	11.071	210.758	.12105	3857.	1000.	5000.	3.792	781.
21	18	.926	.532	5334.	1141.	1.763	5455.	12.072	197.088	.11447	3814.	1000.	5000.	4.117	852.
22	18	.953	.560	5408.	1255.	1.805	5552.	13.064	184.269	.10823	3772.	1000.	5000.	4.435	922.
23	18	.979	.588	5478.	1371.	1.846	5646.	14.049	172.234	.10231	3730.	1000.	5000.	4.745	993.
24	18	1.005	.616	5543.	1488.	1.887	5739.	15.028	160.924	.09668	3688.	1000.	5000.	5.049	1059.
25	18	1.031	.644	5604.	1607.	1.927	5830.	16.000	150.290	.09132	3646.	1000.	5000.	5.347	1126.
26	18	1.057	.672	5661.	1727.	1.968	5919.	16.966	140.286	.08623	3604.	1000.	5000.	5.639	1193.
27	18	1.105	.721	5652.	1550.	1.939	5855.	15.146	147.362	.08984	3634.	1000.	5000.	6.184	1316.
28	18	1.157	.776	5656.	1403.	1.926	5827.	13.930	150.563	.09146	3647.	1000.	5000.	6.869	1471.
29	18	1.214	.832	5670.	1326.	1.924	5823.	13.163	151.075	.09172	3649.	1000.	5000.	7.650	1647.
30	18	1.272	.889	5691.	1283.	1.929	5834.	12.709	149.816	.09108	3644.	1000.	5000.	8.497	1839.
31	18	1.331	.945	5717.	1265.	1.939	5855.	12.477	147.411	.08986	3634.	1000.	5000.	9.388	2040.
32	18	1.389	1.001	5745.	1264.	1.951	5883.	12.403	144.289	.08828	3621.	1000.	5000.	10.306	2248.
33	18	1.447	1.054	5775.	1274.	1.966	5914.	12.442	140.751	.08647	3606.	1000.	5000.	11.233	2458.
34	18	1.503	1.106	5806.	1294.	1.982	5949.	12.561	137.005	.08455	3590.	1000.	5000.	12.158	2669.
35	18	1.557	1.156	5837.	1319.	1.998	5984.	12.735	133.194	.08258	3573.	1000.	5000.	13.069	2876.
36	18	1.609	1.205	5867.	1349.	2.015	6020.	12.948	129.411	.08062	3556.	1000.	5000.	13.962	3080.
37	18	1.658	1.250	5895.	1381.	2.032	6055.	13.182	125.765	.07872	3539.	1000.	5000.	14.820	3277.
38	18	1.707	1.295	5923.	1415.	2.048	6090.	13.439	122.166	.07684	3522.	1000.	5000.	15.669	3472.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	WDOT	F
39	18	1.754	1.339	5951.	1452.	2.065	6125.	13.709	118.666	.07500	3505.	1000.	5000.	16.502	3664.
40	18	1.801	1.382	5977.	1489.	2.082	6160.	13.992	115.233	.07319	3488.	1000.	5000.	17.330	3855.
41	18	1.848	1.425	6004.	1529.	2.099	6196.	14.292	111.804	.07137	3470.	1000.	5000.	18.170	4049.
42	18	1.898	1.471	6032.	1573.	2.118	6233.	14.619	108.249	.06948	3452.	1000.	5000.	19.057	4255.
43	18	1.954	1.523	6062.	1624.	2.179	6276.	15.000	104.325	.06737	3431.	1000.	5000.	20.058	4488.
43		F =	4490.0	FID =		4556.0	ETAF =	.9868	ISP =	223.729	ISPID =	224.452		ETAI =	.9968
11	19	.608	.103	4269.	76.	1.304	4270.	1.024	389.866	.20210	4274.	1000.	5000.	.199	39.
12	19	.665	.173	4444.	177.	1.368	4447.	2.277	357.312	.18794	4212.	1000.	5000.	.542	107.
13	19	.715	.226	4592.	275.	1.424	4600.	3.429	330.097	.17593	4157.	1000.	5000.	.909	181.
14	19	.754	.272	4724.	375.	1.477	4739.	4.539	306.225	.16526	4105.	1000.	5000.	1.277	256.
15	19	.792	.312	4845.	477.	1.526	4868.	5.619	284.796	.15557	4056.	1000.	5000.	1.638	330.
16	19	.827	.349	4956.	580.	1.573	4990.	6.679	265.289	.14664	4008.	1000.	5000.	1.991	404.
17	19	.861	.384	5059.	686.	1.619	5105.	7.721	247.369	.13834	3962.	1000.	5000.	2.335	476.
18	19	.893	.416	5155.	793.	1.664	5216.	8.749	230.802	.13057	3916.	1000.	5000.	2.672	548.
19	19	.923	.448	5245.	903.	1.708	5322.	9.764	215.416	.12328	3871.	1000.	5000.	3.001	619.
20	19	.953	.478	5330.	1014.	1.751	5425.	10.769	201.081	.11640	3827.	1000.	5000.	3.323	689.
21	19	.983	.508	5410.	1127.	1.793	5526.	11.765	187.691	.10990	3783.	1000.	5000.	3.639	759.
22	19	1.012	.538	5484.	1241.	1.835	5623.	12.752	175.163	.10376	3740.	1000.	5000.	3.948	827.
23	19	1.040	.567	5555.	1357.	1.877	5718.	13.732	163.424	.09793	3697.	1000.	5000.	4.252	895.
24	19	1.068	.597	5621.	1475.	1.919	5811.	14.704	152.415	.09240	3654.	1000.	5000.	4.550	962.
25	19	1.096	.626	5683.	1594.	1.960	5902.	15.671	142.083	.08715	3612.	1000.	5000.	4.844	1029.
26	19	1.124	.656	5741.	1715.	2.002	5992.	16.631	132.384	.08216	3570.	1000.	5000.	5.133	1095.
27	19	1.169	.702	5728.	1509.	1.970	5924.	14.763	139.738	.08595	3602.	1000.	5000.	5.617	1205.
28	19	1.223	.755	5729.	1377.	1.956	5892.	13.511	143.226	.08773	3617.	1000.	5000.	6.243	1347.
29	19	1.280	.810	5741.	1296.	1.953	5885.	12.718	144.010	.08813	3620.	1000.	5000.	6.965	1511.
30	19	1.340	.866	5760.	1250.	1.957	5894.	12.247	143.003	.08762	3616.	1000.	5000.	7.757	1691.
31	19	1.400	.922	5784.	1230.	1.966	5914.	12.004	140.832	.08651	3607.	1000.	5000.	8.597	1881.
32	19	1.460	.977	5812.	1227.	1.978	5940.	11.923	137.927	.08502	3594.	1000.	5000.	9.466	2079.
33	19	1.519	1.031	5841.	1237.	1.992	5971.	11.958	134.589	.08330	3579.	1000.	5000.	10.348	2279.
34	19	1.577	1.083	5872.	1256.	2.008	6004.	12.074	131.029	.08146	3563.	1000.	5000.	11.230	2481.
35	19	1.633	1.133	5902.	1281.	2.024	6039.	12.247	127.391	.07957	3547.	1000.	5000.	12.103	2681.
36	19	1.687	1.181	5931.	1310.	2.041	6074.	12.459	123.769	.07768	3530.	1000.	5000.	12.960	2877.
37	19	1.738	1.227	5960.	1342.	2.058	6109.	12.694	120.270	.07585	3513.	1000.	5000.	13.786	3067.
38	19	1.789	1.272	5988.	1377.	2.074	6144.	12.951	116.812	.07403	3496.	1000.	5000.	14.605	3256.
39	19	1.838	1.316	6015.	1413.	2.091	6179.	13.222	113.445	.07224	3479.	1000.	5000.	15.410	3442.
40	19	1.886	1.359	6041.	1451.	2.108	6213.	13.506	110.140	.07049	3462.	1000.	5000.	16.210	3627.
41	19	1.935	1.403	6068.	1491.	2.125	6248.	13.806	106.837	.06872	3444.	1000.	5000.	17.023	3816.
42	19	1.987	1.450	6096.	1535.	2.144	6286.	14.135	103.411	.06688	3426.	1000.	5000.	17.884	4016.
43	19	2.045	1.502	6126.	1586.	2.165	6328.	14.517	99.629	.06483	3404.	1000.	5000.	18.857	4243.
44	19	2.117	1.567	6163.	1651.	2.191	6380.	15.000	95.102	.06237	3378.	1000.	5000.	20.057	4524.
44		F =	4526.1	FID =		4582.4	ETAF =	.9877	ISP =	225.527	ISPID =	226.049		ETAI =	.9977
11	20	.647	.059	4345.	47.	1.331	4346.	.615	375.804	.19601	4247.	1000.	5000.	.062	12.
12	20	.710	.129	4527.	149.	1.398	4530.	1.889	342.570	.18146	4182.	1000.	5000.	.297	59.
13	20	.761	.185	4679.	248.	1.456	4686.	3.034	315.303	.16934	4125.	1000.	5000.	.589	116.
14	20	.807	.232	4814.	348.	1.510	4827.	4.136	291.571	.15865	4072.	1000.	5000.	.899	181.
15	20	.848	.273	4937.	450.	1.561	4958.	5.209	270.375	.14898	4021.	1000.	5000.	1.216	247.
16	20	.886	.312	5058.	554.	1.609	5080.	6.261	251.158	.14010	3972.	1000.	5000.	1.532	313.
17	20	.923	.348	5155.	660.	1.656	5197.	7.295	233.569	.13187	3924.	1000.	5000.	1.847	380.
18	20	.958	.382	5253.	768.	1.702	5309.	8.316	217.362	.12420	3877.	1000.	5000.	2.158	447.
19	20	.992	.415	5345.	878.	1.747	5416.	9.324	202.358	.11702	3831.	1000.	5000.	2.466	514.
20	20	1.025	.447	5431.	985.	1.791	5520.	10.322	188.419	.11026	3786.	1000.	5000.	2.770	580.
21	20	1.057	.478	5512.	1182.	1.836	5621.	11.310	175.438	.10389	3741.	1000.	5000.	3.070	647.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	WDOT	F
22	20	1.089	.510	5588.	1217.	1.878	5719.	12.290	163.525	.09788	3697.	1000.	5000.	3.366	715.
23	20	1.121	.541	5660.	1334.	1.921	5815.	13.262	152.008	.09219	3653.	1000.	5000.	3.659	779.
24	20	1.152	.572	5727.	1452.	1.963	5908.	14.223	141.423	.08681	3609.	1000.	5000.	3.948	844.
25	20	1.183	.605	5790.	1572.	2.006	6000.	15.186	131.517	.08171	3566.	1000.	5000.	4.233	909.
26	20	1.214	.634	5849.	1693.	2.048	6089.	16.139	122.242	.07688	3522.	1000.	5000.	4.515	974.
27	20	1.258	.677	5831.	1476.	2.013	6015.	14.207	129.909	.08788	3558.	1000.	5000.	4.927	1068.
28	20	1.311	.728	5828.	1335.	1.996	5979.	12.907	133.745	.08287	3576.	1000.	5000.	5.478	1194.
29	20	1.369	.781	5836.	1249.	1.991	5968.	12.081	134.868	.08345	3581.	1000.	5000.	6.128	1342.
30	20	1.430	.836	5853.	1200.	1.994	5975.	11.589	134.181	.08309	3578.	1000.	5000.	6.650	1507.
31	20	1.492	.891	5875.	1178.	2.002	5992.	11.333	132.309	.08212	3569.	1000.	5000.	7.623	1683.
32	20	1.554	.945	5902.	1173.	2.014	6017.	11.243	129.684	.08076	3557.	1000.	5000.	8.429	1867.
33	20	1.616	.999	5930.	1182.	2.028	6047.	11.273	126.607	.07916	3543.	1000.	5000.	9.253	2056.
34	20	1.676	1.051	5959.	1200.	2.045	6079.	11.387	123.290	.07743	3527.	1000.	5000.	10.081	2245.
35	20	1.734	1.101	5988.	1225.	2.059	6113.	11.559	119.878	.07564	3511.	1000.	5000.	10.903	2434.
36	20	1.791	1.149	6018.	1254.	2.076	6147.	11.772	116.466	.07384	3494.	1000.	5000.	11.713	2621.
37	20	1.845	1.195	6046.	1286.	2.093	6182.	12.009	113.161	.07209	3477.	1000.	5000.	12.496	2802.
38	20	1.898	1.241	6074.	1321.	2.109	6216.	12.266	109.898	.07035	3460.	1000.	5000.	13.275	2982.
39	20	1.950	1.285	6101.	1357.	2.126	6250.	12.539	106.695	.06864	3443.	1000.	5000.	14.042	3160.
40	20	2.001	1.329	6127.	1395.	2.143	6284.	12.825	103.559	.06696	3426.	1000.	5000.	14.806	3338.
41	20	2.052	1.373	6154.	1435.	2.160	6319.	13.128	100.422	.06526	3409.	1000.	5000.	15.585	3519.
42	20	2.107	1.420	6182.	1474.	2.179	6356.	13.458	97.166	.06350	3390.	1000.	5000.	16.409	3712.
43	20	2.169	1.475	6212.	1531.	2.200	6398.	13.843	93.569	.06153	3369.	1000.	5000.	17.344	3931.
44	20	2.244	1.539	6249.	1596.	2.227	6449.	14.330	89.263	.05916	3343.	1000.	5000.	18.499	4283.
45	20	2.346	1.628	6296.	1687.	2.263	6518.	15.000	83.710	.05608	3507.	1000.	5000.	20.056	4570.

45 F = 4572.1 FID = 4624.1 ETAF = .9888 ISP = 227.820 ISPID = 228.105 ETAI = .9988

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	WDOT	F
11	21	.701	0.000	4450.	0.	1.369	4450.	0.000	356.905	.18776	4211.	1000.	5000.	-.003	-0.
12	21	.771	.072	4651.	102.	1.444	4652.	1.256	321.093	.17192	4138.	1000.	5000.	.086	18.
13	21	.828	.129	4809.	199.	1.505	4813.	2.371	293.864	.15969	4077.	1000.	5000.	.273	56.
14	21	.879	.177	4948.	299.	1.560	4957.	3.455	270.493	.14903	4021.	1000.	5000.	.503	103.
15	21	.925	.221	5074.	401.	1.613	5089.	4.515	249.779	.13946	3968.	1000.	5000.	.754	155.
16	21	.969	.261	5189.	505.	1.663	5214.	5.556	231.104	.13071	3917.	1000.	5000.	1.016	211.
17	21	1.010	.298	5296.	611.	1.711	5332.	6.581	214.131	.12265	3867.	1000.	5000.	1.285	268.
18	21	1.050	.334	5397.	719.	1.759	5444.	7.591	198.507	.11516	3819.	1000.	5000.	1.557	327.
19	21	1.088	.369	5491.	829.	1.805	5553.	8.590	184.135	.10817	3771.	1000.	5000.	1.831	387.
20	21	1.125	.403	5579.	941.	1.851	5656.	9.574	170.840	.10162	3725.	1000.	5000.	2.106	449.
21	21	1.162	.437	5662.	1055.	1.896	5759.	10.557	158.508	.09547	3678.	1000.	5000.	2.381	509.
22	21	1.199	.470	5740.	1171.	1.940	5858.	11.528	147.048	.08968	3633.	1000.	5000.	2.655	571.
23	21	1.235	.504	5813.	1288.	[illegible]	5954.	12.490	136.383	.08423	3587.	1000.	5000.	2.928	633.
24	21	1.271	.537	5882.	1406.	2.029	6048.	13.446	126.446	.07908	3542.	1000.	5000.	3.200	695.
25	21	1.307	.571	5947.	1527.	2.072	6140.	14.395	117.182	.07422	3498.	1000.	5000.	3.471	757.
26	21	1.343	.605	6008.	1648.	2.116	6230.	15.339	108.541	.06963	3453.	1000.	5000.	3.740	820.
27	21	1.383	.642	5981.	1416.	2.076	6147.	13.315	116.546	.07389	3495.	1000.	5000.	4.060	893.
28	21	1.436	.689	5971.	1264.	[illegible]	6134.	11.947	120.805	.07613	3515.	1000.	5000.	4.515	998.
29	21	1.495	.740	5975.	1172.	2.042	6088.	11.077	122.362	.07695	3523.	1000.	5000.	5.070	1126.
30	21	1.558	.793	5998.	1116.	2.049	6091.	10.557	122.099	.07641	3522.	1000.	5000.	5.700	1270.
31	21	1.623	.847	6007.	1090.	2.056	6105.	10.284	120.630	.07604	3515.	1000.	5000.	6.384	1427.
32	21	1.689	.900	6031.	1084.	2.067	6128.	10.186	118.386	.07486	3504.	1000.	5000.	7.105	1593.
33	21	1.754	.953	6058.	1091.	2.080	6156.	10.213	115.668	.07342	3490.	1000.	5000.	7.849	1764.
34	21	1.818	1.004	6086.	1109.	2.095	6186.	10.326	112.687	.07184	3475.	1000.	5000.	8.601	1938.
35	21	1.880	1.055	6115.	1133.	2.111	6219.	10.501	109.589	.07019	3459.	1000.	5000.	9.353	2112.
36	21	1.940	1.103	6143.	1163.	2.127	6252.	10.717	106.469	.06852	3442.	1000.	5000.	10.098	2284.
37	21	1.998	1.149	6171.	1195.	2.144	6286.	10.956	103.435	.06689	3426.	1000.	5000.	10.821	2452.
38	21	2.055	1.195	6198.	1229.	2.161	6319.	11.219	100.418	.06526	3409.	1000.	5000.	11.542	2620.
39	21	2.111	1.240	6225.	1266.	2.177	6353.	11.497	97.470	.06366	3392.	1000.	5000.	12.255	2787.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
40	21	2.166	1.284	6251.	1305.	2.194	6366.	11.787	94.569	.06208	3375.	1000.	5000.	12.969	2954.
41	21	2.221	1.329	6278.	1345.	2.212	6420.	12.095	91.663	.06048	3357.	1000.	5000.	13.697	3124.
42	21	2.280	1.377	6306.	1390.	2.231	6457.	12.430	88.645	.05882	3339.	1000.	5000.	14.470	3306.
43	21	2.347	1.431	6336.	1442.	2.252	6498.	12.821	85.308	.05697	3317.	1000.	5000.	15.349	3513.
44	21	2.429	1.498	6373.	1508.	2.279	6549.	13.314	81.311	.05474	3291.	1000.	5000.	16.439	3771.
45	21	2.540	1.589	6421.	1600.	2.315	6617.	13.993	76.156	.05183	3255.	1000.	5000.	17.912	4120.
46	21	2.700	1.723	6486.	1738.	2.368	6715.	15.000	69.143	.04782	3203.	1000.	5000.	20.053	4630.
46		F =	4633.6	FID =		4680.8	ETAF = .9899		ISP =	230.882	ISPID =		230.901	ETAI = .9999	
12	22	.851	0.000	4842.	0.	1.516	4842.	0.000	289.035	.15750	4066.	1000.	5000.	0.000	0.
13	22	.918	.057	5003.	98.	1.579	5004.	1.123	262.972	.14557	4002.	1000.	5000.	.051	11.
14	22	.976	.107	5146.	199.	1.637	5150.	2.217	240.578	.13516	3943.	1000.	5000.	.172	36.
15	22	1.030	.152	5275.	302.	1.692	5284.	3.276	220.917	.12589	3888.	1000.	5000.	.332	69.
16	22	1.081	.193	5394.	407.	1.744	5409.	4.314	203.307	.11747	3834.	1000.	5000.	.518	107.
17	22	1.129	.233	5504.	514.	1.794	5528.	5.334	187.366	.10975	3782.	1000.	5000.	.721	153.
18	22	1.176	.271	5607.	623.	1.844	5642.	6.338	172.831	.10260	3732.	1000.	5000.	.936	200.
19	22	1.221	.308	5704.	734.	1.892	5751.	7.330	159.509	.09597	3682.	1000.	5000.	1.159	249.
20	22	1.266	.344	5795.	847.	1.939	5856.	8.311	147.254	.08978	3633.	1000.	5000.	1.389	301.
21	22	1.310	.380	5880.	961.	1.986	5958.	9.282	135.950	.08400	3585.	1000.	5000.	1.627	354.
22	22	1.353	.416	5961.	1077.	2.033	6057.	10.244	125.501	.07859	3538.	1000.	5000.	1.861	408.
23	22	1.396	.452	6037.	1195.	2.079	6154.	11.198	115.829	.07351	3491.	1000.	5000.	2.102	463.
24	22	1.440	.489	6108.	1314.	2.125	6248.	12.144	106.865	.06873	3444.	1000.	5000.	2.346	520.
25	22	1.483	.526	6176.	1435.	2.171	6340.	13.084	98.552	.06425	3398.	1000.	5000.	2.590	577.
26	22	1.526	.563	6239.	1558.	2.217	6430.	14.018	90.839	.06003	3352.	1000.	5000.	2.836	634.
27	22	1.562	.593	6199.	1302.	2.168	6334.	11.862	99.111	.06455	3401.	1000.	5000.	3.046	684.
28	22	1.613	.634	6178.	1134.	2.142	6281.	10.399	103.826	.06710	3428.	1000.	5000.	3.388	763.
29	22	1.674	.681	6173.	1030.	2.130	6259.	9.469	105.899	.06822	3439.	1000.	5000.	3.825	864.
30	22	1.743	.731	6180.	969.	2.129	6256.	8.915	106.164	.06836	3441.	1000.	5000.	4.337	983.
31	22	1.809	.783	6195.	940.	2.134	6266.	8.626	105.214	.06785	3435.	1000.	5000.	4.906	1115.
32	22	1.879	.830	6216.	932.	2.144	6285.	8.524	103.469	.06691	3426.	1000.	5000.	5.516	1256.
33	22	1.949	.886	6240.	958.	2.156	6310.	8.553	101.226	.06570	3413.	1000.	5000.	6.154	1404.
34	22	2.019	.937	6266.	956.	2.170	6339.	8.674	98.693	.06433	3399.	1000.	5000.	6.806	1556.
35	22	2.087	.987	6293.	981.	2.186	6369.	8.857	96.016	.06287	3383.	1000.	5000.	7.463	1709.
36	22	2.154	1.035	6321.	1011.	2.202	6401.	9.084	93.291	.06138	3367.	1000.	5000.	8.119	1862.
37	22	2.217	1.082	6348.	1043.	2.218	6433.	9.335	90.620	.05991	3351.	1000.	5000.	8.759	2012.
38	22	2.280	1.128	6375.	1079.	2.235	6465.	9.609	87.953	.05844	3334.	1000.	5000.	9.402	2163.
39	22	2.342	1.173	6401.	1117.	2.252	6498.	9.897	85.335	.05698	3318.	1000.	5000.	10.041	2313.
40	22	2.403	1.218	6427.	1156.	2.269	6530.	10.199	82.752	.05554	3301.	1000.	5000.	10.682	2464.
41	22	2.465	1.263	6454.	1198.	2.287	6564.	10.517	80.160	.05409	3283.	1000.	5000.	11.340	2620.
42	22	2.531	1.312	6481.	1244.	2.306	6599.	10.864	77.464	.05257	3265.	1000.	5000.	12.041	2786.
43	22	2.605	1.367	6512.	1297.	2.327	6640.	11.266	74.479	.05088	3243.	1000.	5000.	12.841	2976.
44	22	2.697	1.436	6549.	1365.	2.355	6690.	11.774	70.901	.04883	3217.	1000.	5000.	13.837	3213.
45	22	2.821	1.530	6597.	1459.	2.392	6757.	12.471	66.283	.04617	3181.	1000.	5000.	15.191	3537.
46	22	3.002	1.668	6664.	1600.	2.446	6853.	13.501	60.003	.04249	3128.	1000.	5000.	17.171	4012.
47	22	3.267	1.875	6752.	1809.	2.525	6990.	15.000	51.830	.03761	3053.	1000.	5000.	20.056	4708.
47		F =	4711.5	FID =		4755.4	ETAF = .9908		ISP =	234.765	ISPID =		234.582	ETAI =1.0008	
13	23	.992	0.000	5162.	0.	1.642	5162.	0.000	238.791	.13433	3938.	1000.	5000.	0.000	0.
14	23	1.057	.050	5310.	102.	1.703	5311.	1.099	217.068	.12406	3876.	1000.	5000.	.035	7.
15	23	1.118	.095	5442.	205.	1.759	5446.	2.156	198.272	.11504	3818.	1000.	5000.	.123	26.
16	23	1.175	.138	5564.	310.	1.813	5573.	3.189	181.597	.10692	3763.	1000.	5000.	.246	53.
17	23	1.229	.179	5677.	417.	1.866	5692.	4.204	166.593	.09951	3709.	1000.	5000.	.394	85.
18	23	1.282	.218	5782.	527.	1.917	5806.	5.203	152.987	.09269	3657.	1000.	5000.	.560	121.
19	23	1.334	.256	5881.	638.	1.967	5916.	6.189	140.581	.08638	3605.	1000.	5000.	.739	162.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
20	23	1.385	.294	5975.	751.	2.016	6022.	7.164	129.225	.08853	3555.	1000.	5000.	.930	285.
21	23	1.435	.332	6062.	866.	2.065	6124.	8.129	118.888	.07507	3506.	1000.	5000.	1.129	258.
22	23	1.485	.370	6145.	983.	2.113	6223.	9.084	109.209	.06999	3457.	1000.	5000.	1.335	297.
23	23	1.535	.409	6223.	1101.	2.161	6320.	10.031	100.371	.06524	3409.	1000.	5000.	1.546	346.
24	23	1.585	.447	6297.	1221.	2.209	6414.	10.971	92.219	.06079	3361.	1000.	5000.	1.763	397.
25	23	1.635	.487	6366.	1342.	2.256	6506.	11.904	84.692	.05663	3313.	1000.	5000.	1.983	449.
26	23	1.686	.527	6431.	1465.	2.304	6596.	12.830	77.740	.05272	3266.	1000.	5000.	2.207	502.
27	23	1.715	.549	6379.	1188.	2.247	6488.	10.553	86.097	.05741	3323.	1000.	5000.	2.346	539.
28	23	1.764	.586	6348.	1006.	2.215	6427.	9.003	91.093	.06017	3354.	1000.	5000.	2.604	595.
29	23	1.825	.629	6336.	893.	2.201	6398.	8.022	93.522	.06150	3369.	1000.	5000.	2.956	678.
30	23	1.894	.677	6337.	828.	2.197	6391.	7.442	94.167	.06186	3373.	1000.	5000.	3.382	777.
31	23	1.966	.726	6348.	796.	2.200	6398.	7.144	93.601	.06155	3369.	1000.	5000.	3.865	889.
32	23	2.041	.777	6365.	786.	2.208	6414.	7.044	92.231	.06080	3361.	1000.	5000.	4.390	1012.
33	23	2.116	.828	6387.	795.	2.220	6436.	7.081	90.348	.05976	3349.	1000.	5000.	4.946	1141.
34	23	2.191	.878	6412.	811.	2.234	6463.	7.213	83.156	.05855	3336.	1000.	5000.	5.519	1276.
35	23	2.265	.927	6438.	837.	2.249	6492.	7.410	85.801	.05724	3321.	1000.	5000.	6.102	1412.
36	23	2.337	.975	6464.	868.	2.265	6522.	7.651	83.378	.05589	3305.	1000.	5000.	6.688	1550.
37	23	2.406	1.021	6491.	902.	2.281	6553.	7.915	80.988	.05455	3289.	1000.	5000.	7.263	1685.
38	23	2.474	1.067	6517.	939.	2.298	6585.	8.203	78.588	.05320	3272.	1000.	5000.	7.843	1822.
39	23	2.541	1.113	6543.	978.	2.315	6616.	8.504	76.226	.05187	3256.	1000.	5000.	8.422	1959.
40	23	2.608	1.158	6569.	1019.	2.332	6648.	8.818	73.838	.05054	3239.	1000.	5000.	9.005	2097.
41	23	2.675	1.204	6596.	1062.	2.350	6681.	9.149	71.537	.04920	3222.	1000.	5000.	9.605	2240.
42	23	2.747	1.253	6623.	1109.	2.369	6716.	9.509	69.088	.04779	3203.	1000.	5000.	10.248	2393.
43	23	2.829	1.310	6654.	1164.	2.391	6755.	9.925	66.375	.04622	3182.	1000.	5000.	10.983	2569.
44	23	2.930	1.380	6692.	1234.	2.418	6815.	10.448	63.119	.04432	3155.	1000.	5000.	11.902	2789.
45	23	3.066	1.475	6741.	1330.	2.456	6871.	11.164	58.925	.04185	3119.	1000.	5000.	13.157	3090.
46	23	3.266	1.617	6808.	1474.	2.511	6966.	12.220	53.198	.03843	3066.	1000.	5000.	15.002	3536.
47	23	3.559	1.831	6898.	1688.	2.592	7102.	13.749	45.767	.03391	2990.	1000.	5000.	17.709	4192.
48	23	3.814	2.022	6966.	1867.	2.661	7212.	15.000	40.275	.03048	2927.	1000.	5000.	20.056	4763.
48		F =	4767.4	FID =		4812.2	ETAF =	.9907	ISP =	237.551	ISPID =		237.386	ETAI =	1.0007
14	24	1.129	0.000	5457.	0.	1.764	5457.	0.000	196.875	.11437	3814.	1000.	5000.	0.000	0.
15	24	1.196	.046	5592.	104.	1.822	5595.	1.061	178.954	.10562	3753.	1000.	5000.	.026	6.
16	24	1.259	.089	5716.	209.	1.878	5720.	2.094	163.174	.09780	3696.	1000.	5000.	.095	21.
17	24	1.320	.130	5832.	316.	1.932	5840.	3.106	149.070	.09071	3641.	1000.	5000.	.194	42.
18	24	1.379	.176	5939.	426.	1.985	5955.	4.103	136.342	.08420	3587.	1000.	5000.	.317	70.
19	24	1.437	.210	6041.	538.	2.036	6064.	5.086	124.790	.07822	3535.	1000.	5000.	.457	101.
20	24	1.493	.249	6136.	651.	2.087	6170.	6.057	114.262	.07268	3483.	1000.	5000.	.612	136.
21	24	1.550	.288	6225.	766.	2.137	6272.	7.017	104.639	.06754	3432.	1000.	5000.	.778	175.
22	24	1.606	.328	6310.	883.	2.187	6372.	7.968	95.823	.06276	3382.	1000.	5000.	.954	215.
23	24	1.663	.368	6390.	1002.	2.236	6468.	8.910	87.734	.05832	3333.	1000.	5000.	1.138	259.
24	24	1.719	.409	6465.	1122.	2.286	6562.	9.845	80.303	.05417	3284.	1000.	5000.	1.329	304.
25	24	1.777	.450	6537.	1244.	2.335	6654.	10.773	73.470	.05030	3236.	1000.	5000.	1.526	350.
26	24	1.854	.492	6603.	1367.	2.384	6743.	11.694	67.184	.04669	3188.	1000.	5000.	1.728	398.
27	24	1.857	.509	6539.	1070.	2.320	6626.	9.296	75.528	.05147	3251.	1000.	5000.	1.814	419.
28	24	1.903	.540	6498.	874.	2.283	6557.	7.661	80.710	.05440	3287.	1000.	5000.	2.010	465.
29	24	1.965	.581	6478.	753.	2.265	6522.	6.631	83.408	.05591	3305.	1000.	5000.	2.294	532.
30	24	2.035	.625	6474.	684.	2.258	6510.	6.030	84.355	.05644	3311.	1000.	5000.	2.650	615.
31	24	2.111	.673	6481.	650.	2.260	6517.	5.729	84.100	.05630	3310.	1000.	5000.	3.062	712.
32	24	2.190	.722	6495.	641.	2.267	6527.	5.636	83.039	.05570	3303.	1000.	5000.	3.518	819.
33	24	2.270	.772	6515.	649.	2.278	6547.	5.687	81.453	.05482	3292.	1000.	5000.	4.005	933.
34	24	2.349	.821	6538.	668.	2.291	6572.	5.836	79.545	.05374	3279.	1000.	5000.	4.512	1052.
35	24	2.428	.870	6563.	696.	2.306	6600.	6.051	77.458	.05257	3264.	1000.	5000.	5.032	1174.
36	24	2.505	.917	6589.	728.	2.321	6629.	6.309	75.287	.05133	3249.	1000.	5000.	5.557	1298.
37	24	2.579	.964	6614.	764.	2.337	6658.	6.591	73.130	.05011	3233.	1000.	5000.	6.076	1421.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
38	24	2.653	1.010	6641.	803.	2.354	6689.	6.895	70.953	.04886	3217.	1000.	5000.	6.601	1545.
39	24	2.725	1.055	6667.	844.	2.371	6720.	7.212	68.803	.04762	3201.	1000.	5000.	7.128	1670.
40	24	2.797	1.100	6693.	886.	2.388	6751.	7.541	66.669	.04639	3184.	1000.	5000.	7.661	1797.
41	24	2.871	1.147	6719.	931.	2.406	6783.	7.886	64.519	.04514	3167.	1000.	5000.	8.213	1929.
42	24	2.949	1.197	6747.	979.	2.426	6818.	8.260	62.277	.04383	3148.	1000.	5000.	8.802	2070.
43	24	3.037	1.253	6778.	1036.	2.448	6857.	8.691	59.789	.04236	3127.	1000.	5000.	9.480	2233.
44	24	3.147	1.324	6816.	1108.	2.476	6905.	9.233	56.801	.04059	3100.	1000.	5000.	10.331	2438.
45	24	3.295	1.422	6865.	1207.	2.514	6971.	9.971	52.941	.03828	3064.	1000.	5000.	11.497	2720.
46	24	3.513	1.567	6934.	1355.	2.570	7065.	11.053	47.691	.03509	3011.	1000.	5000.	13.222	3138.
47	24	3.833	1.786	7026.	1572.	2.653	7199.	12.614	40.878	.03086	2935.	1000.	5000.	15.769	3758.
48	24	4.114	1.983	7096.	1754.	2.723	7309.	13.887	35.856	.02767	2871.	1000.	5000.	17.987	4300.
49	24	4.377	2.173	7153.	1917.	2.786	7405.	15.000	31.829	.02505	2815.	1000.	5000.	20.055	4805.
49		F =	4809.6	FID =		4858.0	ETAF =	.9900	ISP =	239.651	ISPID =		239.642	ETAI =	1.0000
15	25	1.269	0.000	5728.	0.	1.882	5728.	0.000	162.270	.09735	3693.	1000.	5000.	0.000	0.
16	25	1.338	.043	5855.	106.	1.939	5856.	1.035	147.310	.08981	3634.	1000.	5000.	.021	5.
17	25	1.405	.085	5972.	214.	1.995	5976.	2.048	134.034	.08302	3577.	1000.	5000.	.077	17.
18	25	1.469	.126	6082.	323.	2.049	6091.	3.042	122.122	.07682	3522.	1000.	5000.	.161	36.
19	25	1.533	.166	6185.	435.	2.102	6200.	4.023	111.359	.07114	3468.	1000.	5000.	.265	59.
20	25	1.596	.206	6282.	549.	2.154	6306.	4.991	101.592	.06590	3415.	1000.	5000.	.387	87.
21	25	1.659	.247	6374.	664.	2.206	6408.	5.948	92.700	.06105	3364.	1000.	5000.	.523	119.
22	25	1.722	.288	6460.	781.	2.257	6507.	6.895	84.587	.05657	3313.	1000.	5000.	.671	153.
23	25	1.784	.329	6542.	900.	2.308	6603.	7.834	77.171	.05240	3262.	1000.	5000.	.829	191.
24	25	1.848	.371	6619.	1021.	2.359	6697.	8.765	70.384	.04853	3213.	1000.	5000.	.996	230.
25	25	1.912	.415	6692.	1143.	2.409	6789.	9.689	64.167	.04493	3164.	1000.	5000.	1.171	272.
26	25	1.917	.459	6760.	1266.	2.460	6878.	10.606	58.470	.04158	3115.	1000.	5000.	1.352	316.
27	25	1.991	.469	6683.	949.	2.388	6750.	8.082	66.748	.04643	3185.	1000.	5000.	1.397	326.
28	25	2.035	.496	6632.	739.	2.346	6673.	6.359	72.058	.04949	3225.	1000.	5000.	1.544	361.
29	25	2.096	.533	6605.	611.	2.324	6633.	5.282	74.970	.05115	3247.	1000.	5000.	1.774	416.
30	25	2.168	.576	6595.	558.	2.315	6617.	4.664	76.167	.05183	3255.	1000.	5000.	2.072	486.
31	25	2.247	.621	6598.	504.	2.315	6617.	4.366	76.174	.05184	3255.	1000.	5000.	2.425	569.
32	25	2.329	.669	6609.	495.	2.321	6628.	4.286	75.373	.05138	3250.	1000.	5000.	2.821	662.
33	25	2.414	.717	6627.	505.	2.331	6646.	4.357	74.040	.05063	3240.	1000.	5000.	3.248	762.
34	25	2.498	.766	6648.	526.	2.343	6669.	4.527	72.374	.04967	3228.	1000.	5000.	3.699	868.
35	25	2.582	.814	6672.	556.	2.358	6695.	4.765	70.514	.04861	3214.	1000.	5000.	4.163	978.
36	25	2.664	.861	6697.	591.	2.373	6723.	5.045	68.557	.04748	3199.	1000.	5000.	4.635	1090.
37	25	2.744	.907	6723.	629.	2.389	6752.	5.346	66.598	.04635	3183.	1000.	5000.	5.104	1201.
38	25	2.823	.953	6749.	670.	2.405	6782.	5.670	64.610	.04519	3167.	1000.	5000.	5.582	1315.
39	25	2.900	.998	6775.	715.	2.422	6812.	6.005	62.638	.04404	3151.	1000.	5000.	6.062	1429.
40	25	2.978	1.043	6801.	757.	2.440	6843.	6.351	60.677	.04289	3134.	1000.	5000.	6.550	1546.
41	25	3.057	1.090	6827.	804.	2.458	6874.	6.713	58.698	.04172	3117.	1000.	5000.	7.056	1667.
42	25	3.140	1.140	6855.	854.	2.477	6908.	7.103	56.629	.04049	3098.	1000.	5000.	7.601	1798.
43	25	3.235	1.197	6886.	913.	2.500	6947.	7.552	54.331	.03912	3077.	1000.	5000.	8.228	[illegible]
44	25	3.354	1.269	6925.	987.	2.528	6995.	8.113	51.569	.03745	3050.	1000.	5000.	9.018	2140.
45	25	3.514	1.368	6975.	1089.	2.567	7059.	8.874	48.000	.03528	3014.	1000.	5000.	10.104	2403.
46	25	3.750	1.516	7045.	1240.	2.624	7153.	9.986	43.144	.03228	2961.	1000.	5000.	11.720	2796.
47	25	4.098	1.740	7138.	1463.	2.708	7287.	11.581	36.850	.02830	2884.	1000.	5000.	14.121	3383.
48	25	4.402	1.943	7210.	1648.	2.780	7396.	12.876	32.224	.02531	2821.	1000.	5000.	16.222	[illegible]
49	25	4.689	2.138	7269.	1813.	2.844	7491.	14.005	28.526	.02287	2764.	1000.	5000.	18.187	4379.
50	25	4.964	2.330	7318.	1961.	2.904	7576.	15.000	25.502	.02083	2713.	1000.	5000.	20.055	4835.
50		F =	4840.4	FID =		4894.2	ETAF =	.9890	ISP =	241.187	ISPID =		241.429	ETAI =	.9990
16	26	1.413	0.000	5982.	0.	1.997	5982.	0.000	133.381	.08268	3574.	1000.	5000.	0.000	0.
17	26	1.485	.042	6102.	108.	2.055	6103.	1.014	120.880	.07617	3516.	1000.	5000.	.917	4.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
18	26	1.556	.083	6214.	218.	2.118	6218.	2.008	109.729	.07027	3460.	1000.	5000.	.065	15.
19	26	1.626	.124	6319.	330.	2.165	6327.	2.987	99.783	.06487	3405.	1000.	5000.	.137	31.
20	26	1.695	.165	6417.	443.	2.218	6433.	3.953	90.641	.05992	3351.	1000.	5000.	.228	52.
21	26	1.764	.206	6511.	559.	2.271	6535.	4.908	82.423	.05536	3298.	1000.	5000.	.336	77.
22	26	1.833	.248	6595.	676.	2.324	6633.	5.855	74.953	.05115	3247.	1000.	5000.	.458	106.
23	26	1.903	.291	6682.	796.	2.376	6729.	6.789	68.150	.04725	3196.	1000.	5000.	.591	137.
24	26	1.973	.334	6761.	916.	2.428	6823.	7.717	61.947	.04363	3145.	1000.	5000.	.736	172.
25	26	2.044	.379	6835.	1038.	2.481	6914.	8.638	56.285	.04028	3095.	1000.	5000.	.889	209.
26	26	2.116	.425	6906.	1162.	2.533	7003.	9.552	51.114	.03718	3046.	1000.	5000.	1.050	248.
27	26	2.122	.429	6815.	824.	2.452	6865.	6.892	59.296	.04207	3122.	1000.	5000.	1.065	251.
28	26	2.161	.452	6754.	600.	2.405	6780.	5.074	64.703	.04525	3168.	1000.	5000.	1.172	277.
29	26	2.222	.486	6719.	464.	2.379	6734.	3.949	67.795	.04704	3193.	1000.	5000.	1.357	321.
30	26	2.295	.526	6703.	389.	2.368	6714.	3.320	69.208	.04786	3204.	1000.	5000.	1.606	379.
31	26	2.377	.570	6701.	355.	2.366	6711.	3.030	69.443	.04799	3206.	1000.	5000.	1.907	458.
32	26	2.464	.616	6710.	348.	2.370	6719.	2.972	68.871	.04766	3201.	1000.	5000.	2.251	531.
33	26	2.552	.663	6725.	361.	2.379	6735.	3.069	67.760	.04702	3193.	1000.	5000.	2.627	620.
34	26	2.642	.710	6745.	385.	2.391	6756.	3.268	66.303	.04618	3181.	1000.	5000.	3.026	714.
35	26	2.731	.757	6768.	418.	2.405	6781.	3.533	64.640	.04521	3168.	1000.	5000.	3.441	813.
36	26	2.818	.804	6793.	456.	2.420	6808.	3.840	62.868	.04417	3153.	1000.	5000.	3.866	913.
37	26	2.902	.850	6818.	497.	2.436	6836.	4.166	61.080	.04312	3138.	1000.	5000.	4.291	1014.
38	26	2.986	.895	6844.	540.	2.453	6865.	4.513	59.254	.04205	3122.	1000.	5000.	4.725	1118.
39	26	3.069	.941	6870.	585.	2.470	6895.	4.869	57.436	.04097	3106.	1000.	5000.	5.163	1223.
40	26	3.152	.986	6896.	632.	2.487	6925.	5.235	55.623	.03989	3089.	1000.	5000.	5.611	1330.
41	26	3.236	1.033	6923.	681.	2.505	6956.	5.616	53.789	.03879	3072.	1000.	5000.	6.076	1442.
42	26	3.326	1.083	6951.	734.	2.525	6989.	6.024	51.868	.03763	3053.	1000.	5000.	6.578	1563.
43	26	3.428	1.141	6982.	795.	2.548	7027.	6.492	49.733	.03634	3032.	1000.	5000.	7.159	1703.
44	26	3.555	1.213	7021.	871.	2.576	7075.	7.074	47.164	.03477	3005.	1000.	5000.	7.893	1881.
45	26	3.727	1.314	7072.	976.	2.615	7139.	7.862	43.842	.03271	2969.	1000.	5000.	8.907	2127.
46	26	3.981	1.464	7143.	1132.	2.674	7232.	9.005	39.322	.02988	2916.	1000.	5000.	10.422	2497.
47	26	4.356	1.693	7239.	1359.	2.760	7365.	10.635	33.471	.02612	2838.	1000.	5000.	12.688	3052.
48	26	4.685	1.901	7312.	1548.	2.832	7474.	11.952	29.184	.02330	2774.	1000.	5000.	14.681	3542.
49	26	4.994	2.101	7372.	1715.	2.898	7569.	13.097	25.766	.02101	2717.	1000.	5000.	16.551	4000.
50	26	5.292	2.299	7423.	1865.	2.959	7655.	14.104	22.980	.01910	2666.	1000.	5000.	18.355	4436.
51	26	5.582	2.495	7466.	2001.	3.015	7730.	15.000	20.663	.01748	2619.	1000.	5000.	20.055	4856.
51		F =	4861.2	FID =		4921.6	ETAF = .9877		ISP =	242.225	ISPID =	242.782		ETAI.=	.9977
17	27	1.564	0.000	6223.	0.	2.113	6223.	0.000	109.248	.07001	3457.	1000.	5000.	0.000	0.
18	27	1.640	.041	6336.	110.	2.170	6337.	.995	98.809	.06439	3400.	1000.	5000.	.015	3.
19	27	1.716	.083	6443.	222.	2.225	6447.	1.974	89.469	.05928	3344.	1000.	5000.	.056	13.
20	27	1.791	.124	6544.	336.	2.280	6552.	2.939	81.064	.05460	3289.	1000.	5000.	.119	27.
21	27	1.867	.166	6638.	452.	2.335	6654.	3.892	73.470	.05030	3236.	1000.	5000.	.201	47.
22	27	1.942	.209	6728.	569.	2.389	6752.	4.836	66.591	.04634	3183.	1000.	5000.	.297	69.
23	27	2.019	.252	6813.	688.	2.443	6848.	5.770	60.349	.04269	3131.	1000.	5000.	.408	96.
24	27	2.096	.297	6895.	809.	2.496	6941.	6.696	54.677	.03932	3080.	1000.	5000.	.530	125.
25	27	2.174	.343	6969.	932.	2.550	7031.	7.614	49.518	.03621	3030.	1000.	5000.	.663	157.
26	27	2.254	.391	7041.	1056.	2.604	7120.	8.525	44.823	.03332	2980.	1000.	5000.	.804	191.
27	27														
28	27	2.284	.408	6866.	452.	2.461	6880.	3.763	58.314	.04149	3114.	1000.	5000.	.866	206.
29	27	2.343	.439	6822.	309.	2.432	6829.	2.592	61.364	.04341	3142.	1000.	5000.	1.013	241.
30	27	2.418	.476	6800.	232.	2.418	6804.	1.957	63.173	.04435	3155.	1000.	5000.	1.220	290.
31	27	2.503	.518	6794.	200.	2.414	6797.	1.687	63.618	.04461	3159.	1000.	5000.	1.477	351.
32	27	2.595	.562	6800.	197.	2.417	6802.	1.661	63.255	.04440	3156.	1000.	5000.	1.774	421.
33	27	2.687	.608	6813.	213.	2.425	6817.	1.794	62.345	.04387	3149.	1000.	5000.	2.103	499.
34	27	2.781	.654	6832.	242.	2.436	6836.	2.031	61.078	.04312	3138.	1000.	5000.	2.457	582.
35	27	2.875	.701	6854.	279.	2.450	6860.	2.332	59.592	.04225	3125.	1000.	5000.	2.827	670.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
36	27	2.967	.747	6878.	321.	2.464	6886.	2.672	57.984	.04130	3111.	1000.	5000.	3.209	761.
37	27	3.057	.792	6903.	365.	2.480	6913.	3.028	56.345	.04032	3096.	1000.	5000.	3.593	852.
38	27	3.146	.838	6929.	412.	2.496	6941.	3.402	54.662	.03931	3080.	1000.	5000.	3.987	947.
39	27	3.234	.883	6955.	460.	2.513	6970.	3.784	52.979	.03830	3064.	1000.	5000.	4.388	1043.
40	27	3.322	.928	6981.	509.	2.531	6999.	4.173	51.294	.03729	3048.	1000.	5000.	4.797	1141.
41	27	3.412	.975	7008.	561.	2.549	7030.	4.575	49.586	.03625	3031.	1000.	5000.	5.225	1244.
42	27	3.508	1.026	7036.	616.	2.569	7063.	5.005	47.794	.03515	3012.	1000.	5000.	5.688	1356.
43	27	3.617	1.084	7068.	680.	2.592	7101.	5.495	45.799	.03393	2991.	1000.	5000.	6.226	1486.
44	27	3.752	1.157	7108.	760.	2.621	7148.	6.101	43.397	.03244	2964.	1000.	5000.	6.908	1652.
45	27	3.937	1.258	7159.	868.	2.661	7212.	6.916	40.288	.03049	2928.	1000.	5000.	7.854	1882.
46	27	4.208	1.410	7232.	1028.	2.720	7305.	8.093	36.059	.02780	2874.	1000.	5000.	9.276	2230.
47	27	4.619	1.644	7329.	1261.	2.807	7437.	9.761	30.591	.02424	2796.	1000.	5000.	11.416	2756.
48	27	4.964	1.857	7404.	1453.	2.882	7545.	11.101	26.596	.02157	2732.	1000.	5000.	13.308	3221.
49	27	5.297	2.063	7465.	1622.	2.949	7639.	12.262	23.42[illegible]	.01940	2674.	1000.	5000.	15.089	3658.
50	27	5.616	2.265	7517.	1774.	3.010	7724.	13.280	20.840	.01760	2623.	1000.	5000.	16.790	4075.
51	27	5.928	2.467	7562.	1911.	3.068	7799.	14.184	18.701	.01608	2576.	1000.	5000.	18.437	4476.
52	27	6.235	2.670	7601.	2057.	3.121	7869.	15.000	16.893	.01478	2533.	1000.	5000.	20.045	4865.

52 F = 4872.6 F1D = 4940.4 ETAF = .9863 ISP = 242.794 ISPID = 243.707 ETAI = .9963

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
18	28	1.723	0.000	6451.	0.	2.228	6451.	0.000	89.107	.05908	3342.	1000.	5000.	0.000	0.
19	28	1.805	.041	6560.	112.	2.285	6561.	.979	80.411	.05423	3285.	1000.	5000.	.013	3.
20	28	1.887	.083	6662.	226.	2.341	6666.	1.944	72.616	.04981	3230.	1000.	5000.	.049	11.
21	28	1.969	.126	6758.	342.	2.397	5767.	2.896	65.601	.04577	3175.	1000.	5000.	.106	25.
22	28	2.051	.169	6850.	460.	2.453	6865.	3.838	59.269	.04206	3122.	1000.	5000.	.179	42.
23	28	2.135	.214	6936.	579.	2.508	6960.	4.771	53.543	.03864	3070.	1000.	5000.	.267	63.
24	28	2.219	.259	7018.	700.	2.563	7053.	5.695	48.337	.03550	3018.	1000.	5000.	.369	88.
25	28	2.305	.307	7095.	822.	2.618	7143.	6.612	43.656	.03260	2967.	1000.	5000.	.481	115.
26	28	2.393	.356	7169.	946.	2.673	7231.	7.521	39.391	.02992	2917.	1000.	5000.	.604	145.
27	28														
28	28	2.405	.362	6966.	299.	2.515	6972.	2.455	52.859	.03823	3063.	1000.	5000.	.625	150.
29	28	2.463	.390	6912.	149.	2.481	6914.	1.236	56.264	.04027	3095.	1000.	5000.	.740	177.
30	28	2.539	.425	6884.	72.	2.464	6885.	.603	58.062	.04134	3111.	1000.	5000.	.910	219.
31	28	2.626	.465	6874.	44.	2.458	6874.	.365	58.705	.04172	3117.	1000.	5000.	1.127	269.
32	28	2.721	.508	6877.	46.	2.459	6877.	.384	58.535	.04162	3116.	1000.	5000.	1.383	329.
33	28	2.819	.552	6888.	68.	2.466	6889.	.567	57.807	.04119	3109.	1000.	5000.	1.670	397.
34	28	2.918	.597	6906.	103.	2.477	6907.	.852	56.708	.04054	3099.	1000.	5000.	1.982	471.
35	28	3.017	.641	6927.	145.	2.489	6929.	1.198	55.375	.03974	3087.	1000.	5000.	2.312	549.
36	28	3.115	.689	6951.	192.	2.504	6954.	1.578	53.907	.03886	3073.	1000.	5000.	2.655	631.
37	28	3.209	.733	6975.	240.	2.519	6980.	1.970	52.396	.03795	3059.	1000.	5000.	3.001	714.
38	28	3.304	.778	7002.	291.	2.556	7008.	2.377	50.832	.03701	3043.	1000.	5000.	3.359	799.
39	28	3.397	.823	7028.	342.	2.553	7036.	2.787	49.261	.03605	3027.	1000.	5000.	3.724	887.
40	28	3.491	.869	7054.	395.	2.578	7065.	3.203	47.682	.03508	3011.	1000.	5000.	4.099	977.
41	28	3.586	.916	7081.	449.	2.589	7096.	3.629	46.078	.03410	2994.	1000.	5000	4.492	1072.
42	28	3.688	.967	7110.	507.	2.609	7128.	4.082	44.393	.03306	2975.	1000.	5000.	4.920	1175.
43	28	3.803	1.025	7145.	574.	2.632	7166.	4.595	42.514	.03189	2954.	1000.	5000.	5.418	1296.
44	28	3.947	1.099	7183.	657.	2.661	7213.	5.227	40.249	.03046	2927.	1000.	5000.	6.052	1450.
45	28	4.143	1.201	7235.	770.	2.702	7276.	6.072	37.317	.02860	2890.	1000.	5000.	6.936	1666.
46	28	4.433	1.356	7309.	934.	2.762	7369.	7.284	33.330	.02603	2836.	1000.	5000.	8.272	1994.
47	28	4.862	1.594	7408.	1172.	2.851	7501.	8.988	28.181	.02264	2758.	1000.	5000.	10.296	2492.
48	28	5.239	1.811	7485.	1367.	2.926	7608.	10.350	24.433	.02010	2693.	1000.	5000.	12.095	2935.
49	28	5.594	2.022	7547.	1539.	2.995	7703.	11.525	21.462	.01804	2636.	1000.	5000.	13.795	3352.
50	28	5.936	2.230	7600.	1692.	3.058	7786.	12.553	19.055	.01634	2584.	1000.	5000.	15.422	3751.
51	28	6.269	2.437	7646.	1931.	3.116	7862.	13.465	17.065	.01490	2537.	1000.	5000.	17.000	4135.
52	28	6.59[illegible]	2.646	7686.	1957.	3.170	7931.	14.265	15.389	.01367	2494.	1000.	5000.	18.545	4596.
53	28	6.918	2.853	7720.	2069.	3.220	7992.	15.000	13.997	.01263	2455.	1000.	5000.	20.04[illegible]	4867.

I	J	K	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	WDOT	F
53		F =	4874.9	FID =		4950.2	ETAF = .9848		ISP =	242.905	ISPID =	244.191		ETAI = .9947	
19	29	1.893	0.000	6669.	0.	2.343	6669.	0.000	72.340	.04965	3227.	1000.	5000.	0.000	0.
20	29	1.982	.042	6773.	114.	2.401	6774.	.965	65.119	.04549	3171.	1000.	5000.	.011	3.
21	29	2.070	.085	6871.	230.	2.458	6875.	1.917	58.642	.04169	3117.	1000.	5000.	.044	10.
22	29	2.160	.129	6964.	348.	2.515	6973.	2.858	52.816	.03820	3063.	1000.	5000.	.095	23.
23	29	2.251	.174	7052.	467.	2.572	7067.	3.790	47.564	.03501	3010.	1000.	5000.	.162	39.
24	29	2.343	.221	7135.	588.	2.628	7160.	4.713	42.824	.03208	2957.	1000.	5000.	.243	58.
25	29	2.437	.269	7214.	711.	2.684	7249.	5.628	38.541	.02938	2906.	1000.	5000.	.337	81.
26	29	2.532	.319	7289.	835.	2.741	7337.	6.536	34.669	.02690	2855.	1000.	5000.	.442	107.
27	29														
28	29														
29	29	2.578	.341	6997.	-32.	2.529	6997.	-.261	51.448	.03738	3049.	1000.	5000.	.507	122.
30	29	2.655	.374	6961.	-106.	2.509	6962.	-.871	53.446	.03858	3069.	1000.	5000.	.645	155.
31	29	2.746	.411	6946.	-127.	2.500	6947.	-1.051	54.299	.03910	3077.	1000.	5000.	.827	198.
32	29	2.844	.452	6946.	-117.	2.500	6947.	-.962	54.331	.03912	3077.	1000.	5000.	1.045	250.
33	29	2.947	.495	6955.	-86.	2.505	6956.	-.708	53.788	.03879	3072.	1000.	5000.	1.294	309.
34	29	3.052	.540	6972.	-43.	2.515	6972.	-.356	52.855	.03823	3063.	1000.	5000.	1.568	373.
35	29	3.156	.584	6993.	6.	2.527	6993.	.050	51.670	.03751	3051.	1000.	5000.	1.860	443.
36	29	3.252	.629	7016.	59.	2.541	7017.	.484	50.335	.03670	3038.	1000.	5000.	2.166	515.
37	29	3.360	.674	7041.	113.	2.556	7042.	.921	48.941	.03585	3024.	1000.	5000.	2.477	590.
38	29	3.460	.718	7067.	169.	2.573	7069.	1.368	47.486	.03496	3009.	1000.	5000.	2.801	667.
39	29	3.558	.763	7093.	225.	2.589	7097.	1.815	46.015	.03406	2993.	1000.	5000.	3.132	747.
40	29	3.457	.808	7120.	281.	2.607	7126.	2.262	44.531	.03314	2977.	1000.	5000.	3.475	829.
41	29	3.758	.855	7148.	339.	2.626	7156.	2.717	43.019	.03220	2960.	1000.	5000.	3.836	917.
42	29	3.866	.906	7177.	401.	2.646	7188.	3.198	41.427	.03120	2941.	1000.	5000.	4.230	1012.
43	29	3.988	.965	7210.	471.	2.665	7225.	3.738	39.649	.03008	2920.	1000.	5000.	4.690	1124.
44	29	4.141	1.039	7251.	558.	2.699	7272.	4.400	37.505	.02872	2893.	1000.	5000.	5.279	1267.
45	29	4.349	1.142	7304.	675.	2.740	7335.	5.278	34.727	.02694	2856.	1000.	5000.	6.103	1469.
46	29	4.656	1.299	7379.	844.	2.801	7428.	6.527	30.950	.02447	2802.	1000.	5000.	7.358	1777.
47	29	5.112	1.542	7481.	1087.	2.892	7560.	8.270	26.082	.02122	2723.	1000.	5000.	9.272	2248.
48	29	5.513	1.763	7558.	1286.	2.969	7667.	9.654	22.549	.01880	2658.	1000.	5000.	10.982	2670.
49	29	5.892	1.979	7623.	1460.	3.039	7761.	10.844	19.759	.01694	2600.	1000.	5000.	12.605	3069.
50	29	6.255	2.192	7677.	1615.	3.102	7845.	11.882	17.505	.01522	2548.	1000.	5000.	14.163	3450.
51	29	6.609	2.405	7723.	1755.	3.162	7920.	12.800	15.647	.01386	2501.	1000.	5000.	15.676	3818.
52	29	6.958	2.619	7764.	1882.	3.217	7988.	13.625	14.086	.01270	2457.	1000.	5000.	17.159	4175.
53	29	7.299	2.831	7799.	1994.	3.268	8050.	14.343	12.793	.01172	2418.	1000.	5000.	18.600	4519.
54	29	7.639	3.047	7830.	2098.	3.316	8106.	15.000	11.678	.01086	2382.	1000.	5000.	20.027	4856.
54		F =	4868.1	FID =		4951.0	ETAF = .9833		ISP =	242.566	ISPID =	244.229		ETAI = .9932	
20	30	2.077	0.000	6879.	0.	2.460	6879.	0.000	58.428	.04156	3115.	1000.	5000.	0.000	0.
21	30	2.172	.043	6978.	116.	2.519	6979.	.952	52.457	.03799	3059.	1000.	5000.	.010	2.
22	30	2.265	.087	7072.	234.	2.577	7076.	1.893	47.100	.03473	3005.	1000.	5000.	.040	10.
23	30	2.367	.133	7162.	353.	2.635	7170.	2.824	42.287	.03174	2951.	1000.	5000.	.087	21.
24	30	2.468	.180	7246.	474.	2.693	7262.	3.746	37.957	.02901	2899.	1000.	5000.	.148	36.
25	30	2.570	.230	7327.	597.	2.750	7351.	4.660	34.057	.02650	2847.	1000.	5000.	.224	54.
26	30	2.674	.281	7403.	722.	2.808	7438.	5.567	30.541	.02420	2795.	1000.	5000.	.311	76.
27	30														
28	30														
29	30	2.493	.289	7044.	-219.	2.572	7068.	-1.774	47.559	.03501	3010.	1000.	5000.	.332	81.
30	30	2.772	.319	7021.	-287.	2.547	7027.	-2.337	49.786	.03637	3033.	1000.	5000.	.442	107.
31	30	2.866	.355	7001.	-297.	2.535	7007.	-2.428	50.862	.03702	3043.	1000.	5000.	.592	142.
32	30	2.969	.394	6998.	-273.	2.533	7003.	-2.237	51.096	.03716	3046.	1000.	5000.	.776	186.
33	30	3.076	.436	7006.	-231.	2.537	7010.	-1.885	50.724	.03694	3042.	1000.	5000.	.991	236.
34	30	3.186	.479	7022.	-177.	2.545	7024.	-1.445	49.934	.03646	3034.	1000.	5000.	1.229	293.
35	30	3.296	.523	7042.	-118.	2.557	7043.	-.962	48.868	.03581	3023.	1000.	5000.	1.487	354.

I	J	X	Y	U	V	R	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
36	30	3.404	.568	7066.	-57.	2.571	7066.	-.464	47.633	.03505	3010.	1000.	5000.	1.759	418.
37	30	3.518	.612	7091.	3.	2.586	7091.	.028	46.329	.03425	2996.	1000.	5000.	2.038	485.
38	30	3.615	.656	7117.	65.	2.602	7117.	.522	44.947	.03340	2981.	1000.	5000.	2.330	555.
39	30	3.719	.701	7144.	126.	2.619	7145.	1.008	43.545	.03253	2966.	1000.	5000.	2.632	628.
40	30	3.823	.746	7171.	187.	2.637	7174.	1.490	42.126	.03164	2949.	1000.	5000.	2.945	703.
41	30	3.929	.794	7199.	248.	2.656	7204.	1.971	40.677	.03073	2932.	1000.	5000.	3.276	783.
42	30	4.042	.845	7229.	314.	2.676	7236.	2.485	39.149	.02977	2914.	1000.	5000.	3.639	871.
43	30	4.171	.908	7263.	387.	2.700	7273.	3.055	37.441	.02868	2892.	1000.	5000.	4.065	975.
44	30	4.332	.979	7305.	478.	2.730	[illegible]	3.743	35.380	.02736	2865.	1000.	5000.	4.613	1108.
45	30	4.551	1.083	7358.	599.	2.772	7389.	4.652	32.711	.02563	2828.	1000.	5000.	5.385	1297.
46	30	4.875	1.243	7456.	773.	2.834	7476.	5.935	29.087	.02324	2773.	1000.	5000.	6.566	1588.
47	30	5.336	1.489	7548.	1021.	2.927	7608.	7.711	24.429	.02009	2693.	1000.	5000.	8.383	2036.
48	30	5.779	1.714	7619.	1222.	3.005	7716.	9.112	21.052	.01776	2628.	1000.	5000.	10.017	2438.
49	30	6.178	1.936	7684.	1398.	3.076	7810.	10.311	18.412	.01588	2569.	1000.	5000.	11.572	2821.
50	30	6.462	2.154	7739.	1554.	3.141	7894.	11.355	16.279	.01433	2517.	1000.	5000.	13.070	3187.
51	30	6.935	2.372	7786.	1694.	3.201	7969.	12.277	14.525	.01303	2470.	1000.	5000.	14.527	3541.
52	30	7.384	2.591	7828.	1822.	3.257	8037.	13.104	13.055	.01192	2426.	1000.	5000.	15.958	3885.
53	30	7.663	2.808	7863.	1935.	3.308	8098.	13.822	11.842	.01099	2387.	1000.	5000.	17.349	4216.
54	30	8.021	3.024	7895.	2037.	3.357	8154.	14.479	10.797	.01018	2351.	1000.	5000.	18.728	4539.
54	30	7.873	3.036	7869.	2062.	3.341	8139.	14.684	11.141	.01044	2363.	1000.	5000.	20.058	4446.
55	30	8.971	3.162	7886.	2113.	3.366	8164.	15.000	10.619	.01004	2344.	1000.	5000.	20.058	4446.

55 F = 4860.0 F10 = 4947.2 ETAF = .9824 ISP = 242.166 ISP10 = 244.042 ETAI = .9923

ROTATIONAL FLOWFIELD ALONG LEFT-RUNNING CHARACTERISTICS THAT PASS THROUGH THE OBLIQUE SHOCK WAVE.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
55	30	5.671	3.162	7886.	2113.	3.366	8164.	15.000	10.619	.01684	2344.	1000.	5000.	20.058	4446.
55	30	4.971	3.162	7378.	0.	2.768	7378.	.004	28.970	.02267	2831.	879.	5000.	20.058	4446.
21	31	2.275	0.000	7079.	0.	2.579	7079.	0.000	46.934	.03462	3005.	1000.	5000.	0.000	0.
22	31	2.380	.044	7175.	118.	2.658	7176.	.941	42.019	.03158	2948.	1000.	5000.	.009	2.
23	31	2.486	.090	7266.	237.	2.697	7270.	1.872	37.613	.02879	2894.	1000.	5000.	.037	9.
24	31	2.595	.138	7352.	359.	2.757	7361.	2.793	33.659	.02625	2841.	1000.	5000.	.080	19.
25	31	2.705	.188	7434.	482.	2.816	7449.	3.706	30.110	.02392	2789.	1000.	5000.	.137	33.
26	31	2.819	.241	7511.	606.	2.875	7536.	4.612	26.920	.02179	2737.	1000.	5000.	.207	51.
27	31														
28	31														
29	31														
30	31	2.841	.266	7076.	-516.	2.578	7095.	-4.169	46.117	.03412	2994.	1000.	5000.	.266	65.
31	31	2.979	.299	7050.	-504.	2.572	7068.	-4.092	47.518	.03498	3009.	1000.	5000.	.387	93.
32	31	3.087	.336	7044.	-459.	2.566	7059.	-3.727	48.028	.03530	3015.	1000.	5000.	.540	129.
33	31	3.201	.376	7050.	-396.	2.568	7062.	-3.218	47.880	.03521	3013.	1000.	5000.	.721	172.
34	31	3.317	.418	7066.	-326.	2.575	7073.	-2.644	47.266	.03483	3006.	1000.	5000.	.927	220.
35	31	3.432	.461	7086.	-254.	2.586	7091.	-2.051	46.337	.03426	2997.	1000.	5000.	1.151	274.
36	31	3.547	.505	7110.	-181.	2.599	7112.	-1.461	45.211	.03356	2984.	1000.	5000.	1.391	331.
37	31	3.658	.549	7135.	-112.	2.614	7136.	-.896	43.989	.03280	2971.	1000.	5000.	1.639	390.
38	31	3.768	.593	7162.	-42.	2.630	7162.	-.340	42.685	.03199	2956.	1000.	5000.	1.901	453.
39	31	3.878	.638	7190.	25.	2.647	7190.	.198	41.348	.03115	2940.	1000.	5000.	2.173	518.
40	31	3.987	.683	7218.	91.	2.665	7218.	.724	39.988	.03030	2924.	1000.	5000.	2.458	587.
41	31	4.199	.730	7246.	158.	2.684	7248.	1.248	38.594	.02942	2907.	1000.	5000.	2.760	660.
42	31	4.218	.782	7277.	228.	2.704	7281.	1.792	37.122	.02848	2888.	1000.	5000.	3.094	741.
43	31	4.353	.841	7312.	306.	2.729	7318.	2.393	35.475	.02742	2866.	1000.	5000.	3.487	836.
44	31	4.522	.917	7354.	400.	2.759	7365.	3.116	33.486	.02613	2839.	1000.	5000.	3.995	960.
45	31	4.753	1.023	7410.	526.	2.802	7429.	4.060	30.912	.02445	2801.	1000.	5000.	4.716	1137.
46	31	5.093	1.184	7488.	705.	2.865	7522.	5.380	27.422	.02213	2746.	1000.	5000.	5.826	1410.
47	31	5.600	1.436	7594.	958.	2.959	7654.	7.190	22.950	.01908	2665.	1000.	5000.	7.548	1835.
48	31	6.045	1.666	7675.	1162.	3.039	7762.	8.607	19.733	.01682	2599.	1000.	5000.	9.106	2219.
49	31	6.466	1.892	7741.	1339.	3.111	7856.	9.816	17.209	.01501	2541.	1000.	5000.	10.597	2586.
50	31	6.869	2.115	7797.	1497.	3.177	7940.	10.865	15.184	.01352	2488.	1000.	5000.	12.036	2937.
51	31	7.263	2.337	7845.	1637.	3.238	8014.	11.789	13.525	.01228	2441.	1000.	5000.	13.440	3277.
52	31	7.653	2.561	7887.	1766.	3.295	8082.	12.618	12.138	.01122	2397.	1000.	5000.	14.821	3608.
53	31	8.028	2.783	7923.	1878.	3.348	8143.	13.336	10.996	.01333	2358.	1000.	5000.	16.164	3927.
54	31	8.404	3.009	7956.	1982.	3.397	8199.	13.993	10.015	.00956	2321.	1000.	5000.	17.496	4238.
55	31	8.488	3.060	7962.	2002.	3.407	8210.	14.116	9.825	.00941	2314.	1000.	5000.	18.948	4587.
55	31	8.488	3.068	7434.	-108.	2.806	7435.	-.773	26.907	.02131	2797.	878.	5000.	18.948	4587.
56	31	4.764	3.162	7474.	0.	2.833	7474.	0.000	25.646	.02048	2774.	879.	5000.	19.737	4779.

56 F = 4860.0 F1D = 4947.2 ETAF = .9824 ISP = 242.166 ISP1D = 244.042 ETAI = .9923

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
22	32	2.492	0.000	7272.	0.	2.699	7272.	0.000	37.483	.02871	2893.	1000.	5000.	0.000	0.
23	32	2.607	.046	7365.	120.	2.760	7365.	.931	33.456	.02612	2838.	1000.	5000.	.009	2.
24	32	2.724	.095	7452.	241.	2.820	7456.	1.852	29.853	.02375	2785.	1000.	5000.	.034	8.
25	32	2.844	.145	7535.	364.	2.881	7544.	2.765	26.625	.02159	2732.	1000.	5000.	.074	18.
26	32	2.968	.198	7614.	488.	2.942	7630.	3.670	23.734	.01962	2680.	1000.	5000.	.128	31.
27	32														
28	32														
29	32														
30	32														

I	J	X	Y	U	V	W	VMAG	THETA	P	RHO	T	PT	TT	WDOT	F
31	32	3.086	.242	7089.	-765.	2.610	7130.	-6.141	44.323	.03301	2974.	1000.	5000.	.222	54.
32	32	3.201	.277	7078.	-678.	2.598	7111.	-5.475	45.286	.03361	2985.	1000.	5000.	.346	83.
33	32	3.322	.315	7084.	-583.	2.596	7108.	-4.704	45.457	.03371	2987.	1000.	5000.	.496	118.
34	32	3.445	.356	7098.	-487.	2.601	7115.	-3.921	45.068	.03347	2983.	1000.	5000.	.670	159.
35	32	3.567	.398	7119.	-393.	2.610	7130.	-3.162	44.295	.03299	2974.	1000.	5000.	.863	204.
36	32	3.687	.441	7144.	-308.	2.622	7150.	-2.444	43.277	.03236	2963.	1000.	5000.	1.072	254.
37	32	3.804	.484	7170.	-225.	2.637	7174.	-1.778	42.134	.03165	2949.	1000.	5000.	1.290	306.
38	32	3.921	.528	7198.	-143.	2.653	7199.	-1.142	40.890	.03087	2935.	1000.	5000.	1.524	362.
39	32	4.035	.573	7226.	-68.	2.670	7226.	-.538	39.601	.03005	2919.	1000.	5000.	1.768	421.
40	32	4.150	.619	7255.	5.	2.688	7255.	.041	38.282	.02922	2903.	1000.	5000.	2.025	483.
41	32	4.266	.666	7284.	78.	2.707	7285.	.610	36.925	.02835	2885.	1000.	5000.	2.300	549.
42	32	4.392	.718	7316.	152.	2.728	7318.	1.193	35.490	.02743	2866.	1000.	5000.	2.605	623.
43	32	4.534	.778	7352.	255.	2.753	7355.	1.831	33.883	.02639	2844.	1000.	5000.	2.968	712.
44	32	4.711	.854	7395.	334.	2.794	7403.	2.590	31.944	.02513	2816.	1000.	5000.	3.439	827.
45	32	4.953	.962	7452.	465.	2.828	7467.	3.570	29.436	.02347	2778.	1000.	5000.	4.110	992.
46	32	5.309	1.126	7533.	649.	2.893	7561.	4.926	26.045	.02120	2722.	1000.	5000.	5.155	1249.
47	32	5.843	1.342	7641.	806.	2.999	7690.	6.765	21.719	.01822	2641.	1000.	5000.	6.788	1652.
48	32	6.307	1.617	7723.	1112.	3.070	7802.	8.195	18.622	.01603	2574.	1000.	5000.	8.278	2019.
49	32	6.747	1.847	7798.	1291.	3.143	7897.	9.410	16.203	.01427	2515.	1000.	5000.	9.709	2371.
50	32	7.169	2.075	7847.	1449.	3.210	7980.	10.462	14.269	.01284	2462.	1000.	5000.	11.096	2709.
51	32	7.561	2.303	7896.	1590.	3.272	8055.	11.386	12.688	.01164	2415.	1000.	5000.	12.452	3037.
52	32	7.986	2.530	7939.	1718.	3.330	8123.	12.214	11.371	.01062	2371.	1000.	5000.	13.787	3356.
53	32	8.341	2.756	7975.	1831.	3.383	8183.	12.931	10.289	.00978	2332.	1000.	5000.	15.087	3663.
54	32	8.774	2.988	8008.	1935.	3.433	8239.	13.586	9.361	.00903	2295.	1000.	5000.	16.378	3964.
55	32	8.774	5.987	8008.	1931.	3.432	8237.	13.561	9.380	.00905	2296.	1000.	5000.	19.181	4663.
55	32	8.774	2.987	7469.	-161.	2.830	7471.	-1.234	25.699	.02051	2776.	878.	5000.	19.181	4663.
56	32	9.105	3.070	7501.	-78.	2.852	7502.	-.592	24.712	.01985	2757.	878.	5000.	20.933	5086.
57	32	9.256	3.142	7531.	0.	2.872	7531.	0.000	23.807	.01925	2740.	879.	5000.	22.821	5544.

57 F = 4560.0 FIO = 4947.2 ETAF = .9824 ISP = 242.166 ISPID = 244.042 ETAI = .9923

I	J	X	Y	U	V	W	VMAG	THETA	P	RHO	T	PT	TT	WDOT	F
23	33	2.730	0.000	7459.	0.	2.822	7459.	0.000	29.752	.02368	2783.	1000.	5000.	0.000	0.
24	33	2.857	.048	7547.	121.	2.884	7548.	.921	26.474	.02149	2730.	1000.	5000.	.008	2.
25	33	2.986	.100	7632.	244.	2.946	7636.	1.834	23.543	.01948	2677.	1000.	5000.	.031	8.
26	33	3.120	.153	7712.	369.	3.008	7721.	2.738	20.924	.01766	2625.	1000.	5000.	.069	17.
27	33														
28	33														
29	33														
30	33														
31	33	3.197	.179	7080.	-1028.	2.625	7154.	-8.263	43.084	.03224	2960.	1000.	5000.	.112	27.
32	33	3.320	.212	7068.	-869.	2.605	7122.	-7.007	44.732	.03327	2979.	1000.	5000.	.209	50.
33	33	3.447	.249	7075.	-719.	2.598	7111.	-5.792	45.259	.03359	2985.	1000.	5000.	.331	78.
34	33	3.576	.289	7092.	-582.	2.601	7116.	-4.695	45.019	.03344	2982.	1000.	5000.	.476	112.
35	33	3.703	.331	7116.	-462.	2.610	7131.	-3.717	44.280	.03299	2974.	1000.	5000.	.641	151.
36	33	3.829	.375	7142.	-355.	2.623	7151.	-2.845	43.237	.03234	2962.	1000.	5000.	.823	194.
37	33	3.958	.419	7171.	-259.	2.638	7175.	-2.072	42.043	.03159	2948.	1000.	5000.	1.016	240.
38	33	4.070	.464	7200.	-171.	2.655	7202.	-1.357	40.739	.03077	2933.	1000.	5000.	1.225	290.
39	33	4.188	.509	7230.	-88.	2.673	7231.	-.697	39.391	.02992	2917.	1000.	5000.	1.447	343.
40	33	4.307	.556	7261.	-10.	2.692	7261.	-.076	38.016	.02905	2899.	1000.	5000.	1.682	400.
41	33	4.427	.605	7292.	67.	2.712	7292.	.525	36.607	.02815	2881.	1000.	5000.	1.935	461.
42	33	4.556	.657	7325.	145.	2.734	7326.	1.132	35.125	.02719	2861.	1000.	5000.	2.219	530.
43	33	4.702	.719	7362.	230.	2.760	7365.	1.790	33.473	.02613	2838.	1000.	5000.	2.559	613.
44	33	4.884	.797	7406.	332.	2.792	7414.	2.564	31.490	.02483	2810.	1000.	5000.	3.001	721.
45	33	5.131	.907	7466.	464.	2.837	7480.	3.556	28.944	.02314	2771.	1000.	5000.	3.638	877.
46	33	5.497	1.075	7548.	649.	2.903	7576.	4.915	25.527	.02084	2713.	1000.	5000.	4.637	1123.
47	33	6.042	1.336	7658.	906.	3.001	7711.	6.747	21.205	.01786	2631.	1000.	5000.	6.214	1513.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	WDOT	F
48	33	6.523	1.576	7741.	1111.	3.084	7821.	8.167	16.134	.01568	2563.	1000.	5000.	7.662	1878.
49	33	6.972	1.811	7819.	1289.	3.158	7916.	9.370	15.747	.01394	2503.	1000.	5000.	9.060	2213.
50	33	7.405	2.043	7868.	1446.	3.226	7999.	10.411	13.846	.01252	2450.	1000.	5000.	10.418	2546.
51	33	7.827	2.274	7917.	1586.	3.288	8074.	11.326	12.298	.01134	2402.	1000.	5000.	11.748	2865.
52	33	8.242	2.507	7960.	1712.	3.347	8142.	12.144	11.011	.01034	2356.	1000.	5000.	13.060	3178.
53	33	8.646	2.738	7997.	1824.	3.400	8202.	12.852	9.956	.00951	2319.	1000.	5000.	14.339	3479.
54	33														
55	33	8.983	2.933	8024.	1907.	3.441	8248.	13.371	9.299	.00891	2289.	1000.	5000.	17.412	4230.
55	33	8.983	2.933	7484.	-178.	2.841	7487.	-1.360	25.196	.02018	2767.	878.	5000.	17.412	4230.
56	33	9.189	3.001	7511.	-107.	2.859	7512.	-.818	24.582	.01963	2751.	878.	5000.	18.842	4576.
57	33	9.436	3.005	7541.	-28.	2.879	7541.	-.216	23.483	.01903	2734.	879.	5000.	20.703	5027.
58	33	9.618	3.167	7552.	0.	2.886	7552.	0.000	23.162	.01881	2727.	879.	5000.	22.021	5347.
58		F =	4960.9	F10 =		4947.2	ETAF =	.9824	ISP =	242.166	ISP10 =	244.042		ETAI =	.9923
24	34	2.993	0.000	7638.	0.	2.948	7638.	0.000	23.463	.01943	2675.	1000.	5000.	0.000	0.
25	34	3.133	.051	7724.	123.	3.011	7725.	.912	20.810	.01758	2622.	1000.	5000.	.007	2.
26	34	3.278	.105	7805.	246.	3.075	7809.	1.817	18.442	.01590	2570.	1000.	5000.	.029	7.
27	34														
28	34														
29	34														
30	34														
31	34														
32	34	3.422	.151	7396.	-1224.	2.629	7161.	-9.841	42.748	.03203	2957.	1000.	5000.	.093	22.
33	34	3.562	.182	7364.	-949.	2.608	7127.	-7.654	44.457	.03308	2976.	1000.	5000.	.186	44.
34	34	3.709	.224	7284.	-736.	2.605	7123.	-5.929	44.687	.03324	2979.	1000.	5000.	.302	71.
35	34	3.834	.266	7111.	-567.	2.612	7134.	-4.555	44.117	.03288	2972.	1000.	5000.	.438	102.
36	34	3.966	.310	7141.	-428.	2.625	7154.	-3.429	43.098	.03225	2961.	1000.	5000.	.592	139.
37	34	4.092	.354	7172.	-312.	2.640	7179.	-2.491	41.869	.03148	2946.	1000.	5000.	.759	179.
38	34	4.217	.400	7204.	-209.	2.658	7207.	-1.663	40.508	.03063	2930.	1000.	5000.	.943	223.
39	34	4.339	.446	7236.	-117.	2.677	7237.	-.925	39.098	.02974	2913.	1000.	5000.	1.141	270.
40	34	4.461	.494	7268.	-31.	2.697	7268.	-.248	37.665	.02882	2895.	1000.	5000.	1.353	321.
41	34	4.584	.543	7301.	59.	2.718	7301.	.394	36.204	.02789	2876.	1000.	5000.	1.584	377.
42	34	4.718	.597	7335.	132.	2.741	7337.	1.031	34.673	.02690	2855.	1000.	5000.	1.845	440.
43	34	4.860	.669	7374.	220.	2.767	7377.	1.712	32.978	.02580	2831.	1000.	5000.	2.158	517.
44	34	5.033	.742	7420.	325.	2.801	7427.	2.505	30.956	.02448	2802.	1000.	5000.	2.573	618.
45	34	5.319	.837	7481.	459.	2.847	7495.	3.508	28.377	.02277	2761.	1000.	5000.	3.174	766.
46	34	5.985	1.023	7566.	695.	2.916	7595.	5.871	24.945	.02045	2703.	1000.	5000.	4.124	1000.
47	34	6.345	1.290	7678.	931.	3.016	7730.	6.697	20.639	.01746	2619.	1000.	5000.	5.641	1374.
48	34	6.727	1.532	7763.	1109.	3.092	7841.	8.105	17.604	.01529	2550.	1000.	5000.	7.044	1720.
49	34	7.200	1.775	7832.	1282.	3.175	7936.	9.297	15.258	.01357	2490.	1000.	5000.	8.405	2054.
50	34	7.645	2.011	7891.	1420.	3.243	8020.	10.327	13.396	.01218	2437.	1000.	5000.	9.732	2377.
51	34	8.078	2.246	7940.	1577.	3.307	8095.	11.232	11.884	.01102	2389.	1000.	5000.	11.034	2691.
52	34	8.503	2.483	7984.	1723.	3.365	8162.	12.002	10.629	.01004	2345.	1000.	5000.	12.321	2997.
53	34	8.920	2.718	8021.	1814.	3.419	8224.	12.742	9.604	.00923	2305.	1000.	5000.	13.576	3292.
54	34														
55	34	9.196	2.878	8044.	1860.	3.453	8260.	13.154	9.015	.00876	2281.	1000.	5000.	16.270	3951.
55	34	9.195	2.878	7501.	-199.	2.852	7504.	-1.521	24.649	.01981	2756.	878.	5000.	16.270	3951.
56	34	9.356	2.933	7523.	-142.	2.867	7524.	-1.081	24.007	.01950	2744.	878.	5000.	17.387	4221.
57	34	9.618	3.027	7553.	-62.	2.887	7553.	-.468	23.116	.01878	2727.	878.	5000.	19.217	4664.
58	34	9.801	3.097	7563.	-33.	2.895	7563.	-.247	22.800	.01857	2720.	879.	5000.	20.505	4977.
59	34	9.992	3.162	7575.	0.	2.903	7575.	0.000	22.443	.01833	2713.	879.	5000.	21.931	5300.
59		F =	4958.9	F10 =		4947.2	ETAF =	.9824	ISP =	242.166	ISP10 =	244.042		ETAI =	.9923
23	35	3.289	0.000	7611.	0.	2.977	7611.	0.000	18.379	.01585	2569.	1000.	5000.	0.000	0.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
26	35	3.44	.054	7394.	125.	3.142	7895.	.904	16.245	.01430	2516.	1000.	5000.	.007	2.
27	35														
28	35														
29	35														
30	35														
31	35														
32	35	3.528	.079	6893.	-1597.	2.576	7075.	-13.045	47.143	.03475	3005.	1000.	5000.	.029	7.
33	35	3.682	.114	6930.	-968.	2.530	6998.	-7.955	51.395	.03735	3049.	1000.	5000.	.094	21.
34	35	3.824	.156	6970.	-625.	2.530	6998.	-5.129	51.399	.03735	3049.	1000.	5000.	.183	42.
35	35	3.959	.203	7011.	-408.	2.545	7023.	-3.329	50.003	.03650	3035.	1000.	5000.	.297	69.
36	35	4.089	.251	7051.	-252.	2.565	7056.	-2.049	48.183	.03539	3016.	1000.	5000.	.432	101.
37	35	4.213	.299	7090.	-133.	2.586	7091.	-1.073	46.293	.03423	2996.	1000.	5000.	.584	137.
38	35	4.335	.349	7126.	-32.	2.609	7128.	-.255	44.386	.03305	2975.	1000.	5000	.755	178.
39	35	4.455	.398	7165.	56.	2.632	7165.	.451	42.531	.03190	2954.	1000.	5000.	.942	222.
40	35	4.574	.449	7201.	137.	2.655	7203.	1.086	40.727	.03076	2933.	1000.	5000.	1.146	272.
41	35	4.696	.502	7237.	212.	2.679	7240.	1.682	38.951	.02964	2911.	1000.	5000.	1.370	326.
42	35	4.825	.559	7274.	288.	2.704	7280.	2.271	37.139	.02849	2888.	1000.	5000.	1.626	388.
43	35	4.972	.624	7315.	370.	2.733	7325.	2.898	35.178	.02723	2862.	1000.	5000.	1.936	463.
44	35	5.154	.708	7365.	467.	2.769	7379.	3.630	32.886	.02574	2830.	1000.	5000.	2.348	564.
45	35	5.403	.824	7428.	592.	2.817	7452.	4.560	30.020	.02386	2787.	1000.	5000.	2.950	712.
46	35	5.770	1.001	7515.	768.	2.888	7554.	5.834	26.277	.02135	2726.	1000.	5000.	3.909	948.
47	35	6.316	1.275	7629.	1012.	2.990	76[illegible]	7.559	21.666	.01818	2640.	1000.	5000.	5.448	1328.
48	35	6.796	1.524	7715.	1208.	3.075	7809.	8.900	18.452	.01590	2570.	1000.	5000.	6.878	1680.
49	35	7.248	1.767	7785.	1379.	3.150	7906.	10.043	15.981	.01411	2509.	1000.	5000.	8.268	2021.
50	35	7.682	2.006	7843.	1530.	3.219	7991.	11.035	14.028	.01266	2455.	1000.	5000.	9.624	2351.
51	35	-------------------													
51	35	8.078	2.246	7940.	1577.	3.307	8095.	11.232	11.884	.01102	2389.	1000.	5000.	11.034	2691.
52	35	8.503	2.483	7984.	1703.	3.365	8163.	12.042	10.629	.01004	2345.	1000.	5000.	12.321	2997.
53	35	8.918	2.718	8021.	1814.	3.419	8224.	12.742	9.609	.00923	2305.	1000.	5000.	13.576	3292.
54	35														
55	35	9.196	2.878	8044.	1880.	3.4[illegible]5	8260.	13.154	9.015	.00876	2281.	1000.	5000.	13.576	3292.
55	35	9.196	2.878	7501.	-199.	2.853	7504.	-1.521	24.642	.01981	2756.	878.	5000.	13.576	3292.
56	35	9.356	2.933	7523.	-142.	2.867	7524.	-1.081	24.007	.01938	2744.	878.	5000.	17.387	4221.
57	35	9.618	3.027	7553.	-62.	2.887	7553.	-.468	23.116	.01878	2727.	878.	5000.	19.217	4664.
58	35	9.803	3.093	7563.	-33.	2.895	7563.	-.247	22.800	.01857	2720.	879.	5000.	20.505	4977.
59	35	9.992	3.162	7575.	0.	2.903	7575.	0.000	22.443	.01833	2713.	879.	5000.	21.831	5300.
26	36	3.605	0.000	7979.	0.	3.289	7979.	0.000	14.294	.01286	2463.	1000.	5000.	0.000	0.
27	36														
28	36														
29	36														
30	36														
31	36														
32	36														
33	36	3.775	.055	6782.	-1265.	2.472	6899.	-10.565	57.195	.04063	3104.	1000.	5000.	.029	6.
34	36	3.928	.100	6857.	-565.	2.461	6880.	-4.708	58.322	.04150	3114.	1000.	5000.	.088	20.
35	36	4.065	.151	6920.	-269.	2.487	6925.	-2.226	55.585	.03987	3089.	1000.	5000.	.178	41.
36	36	4.194	.203	6975.	-98.	2.517	6976.	-.803	52.657	.03811	3061.	1000.	5000.	.293	68.
37	36	4.316	.254	7023.	21.	2.545	7023.	.171	49.986	.03649	3035.	1000.	5000.	.429	100.
38	36	4.436	.307	7068.	116.	2.572	7069.	.944	47.506	.03498	3009.	1000.	5000.	.586	138.
39	36	4.554	.359	7109.	198.	2.599	7112.	1.594	45.218	.03357	2984.	1000.	5000.	.762	180.
40	36	4.672	.412	7149.	271.	2.625	7154.	2.173	43.076	.03224	2960.	1000.	5000.	.956	227.
41	36	4.791	.467	7188.	341.	2.651	7196.	2.714	41.023	.03095	2936.	1000.	5000.	1.173	279.
42	36	4.917	.527	7228.	411.	2.678	7240.	3.250	38.974	.02966	2911.	1000.	5000.	1.421	340.
43	36	5.061	.595	7272.	486.	2.709	7288.	3.824	36.795	.02827	2884.	1000.	5000.	1.725	414.
44	36	5.241	.681	7323.	576.	2.747	7346.	4.497	34.289	.02665	2850.	1000.	5000.	2.132	513.
45	36	5.485	.801	7389.	693.	2.797	7421.	5.360	31.201	.02464	2805.	1000.	5000.	2.731	660.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
46	36	5.846	.982	7478.	860.	2.869	7527.	6.557	27.225	.02199	2742.	1000.	5000.	3.691	897.
47	36	6.384	1.261	7594.	1094.	2.973	7672.	8.198	22.389	.01869	2654.	1000.	5000.	5.242	1279.
48	36	6.856	1.514	7680.	1283.	3.058	7787.	9.486	19.044	.01633	2584.	1000.	5000.	6.688	1635.
49	36	7.301	1.759	7751.	1449.	3.134	7885.	10.590	16.486	.01448	2522.	1000.	5000.	8.096	1980.
50	36	7.727	2.000	7810.	1596.	3.203	7971.	11.552	14.468	.01299	2468.	1000.	5000.	9.472	2315.
51	36	8.142	2.240	7860.	1728.	3.266	8047.	12.402	12.837	.01175	2419.	1000.	5000.	10.824	2641.
52	36	8.549	2.479	7903.	1849.	3.325	8116.	13.166	11.486	.01071	2375.	1000.	5000.	12.161	2959.
53	36	-------------------													
53	36	8.918	2.718	8021.	1814.	3.419	8224.	12.742	9.604	.00923	2305.	1000.	5000.	13.576	3292.
54	36														
55	36	9.196	2.878	8044.	1880.	3.453	8260.	13.154	9.015	.00876	2281.	1000.	5000.	13.576	3292.
55	36	9.196	2.878	7501.	-199.	2.853	7504.	-1.521	24.649	.01981	2756.	878.	5000.	13.576	3292.
56	36	9.356	2.933	7523.	-142.	2.867	7524.	-1.081	24.007	.01938	2744.	878.	5000.	17.387	4221.
57	36	9.618	3.027	7553.	-62.	2.887	7553.	-.468	23.116	.01878	2727.	878.	5000.	19.217	4664.
58	36	9.803	3.093	7563.	-33.	2.895	7563.	-.247	22.800	.01857	2720.	879.	5000.	20.505	4977.
59	36	9.992	3.162	7575.	0.	2.903	7575.	0.000	22.443	.01833	2713.	879.	5000.	21.831	5300.
33	37	3.659	0.000	5743.	0.	1.888	5743.	0.000	160.410	.09642	3686.	1000.	5000.	0.000	0.
34	37	3.983	.072	6255.	741.	2.150	6299.	6.758	102.259	.06626	3419.	1000.	5000.	.038	9.
35	37	-------------------													
35	37	4.065	.151	6920.	-269.	2.487	6925.	-2.226	55.585	.03987	3389.	1000.	5000.	.178	41.
36	37	4.194	.203	6975.	-98.	2.517	6976.	-.803	52.657	.03811	3061.	1000.	5000.	.293	68.
37	37	4.316	.254	7023.	21.	2.545	7023.	.171	49.988	.03649	3035.	1000.	5000.	.429	100.
38	37	4.436	.307	7068.	116.	2.572	7069.	.944	47.506	.03498	3009.	1000.	5000.	.586	138.
39	37	4.554	.359	7109.	198.	2.599	7112.	1.594	45.218	.03357	2984.	1000.	5000.	.762	180.
40	37	4.671	.412	7149.	271.	2.625	7154.	2.173	43.076	.03224	2960.	1000.	5000.	.956	227.
41	37	4.791	.467	7188.	341.	2.651	7196.	2.714	41.023	.03095	2936.	1000.	5000.	1.173	279.
42	37	4.917	.527	7228.	411.	2.678	7240.	3.250	38.974	.02966	2911.	1000.	5000.	1.421	340.
43	37	5.061	.595	7272.	486.	2.709	7288.	3.824	36.795	.02827	2884.	1000.	5000.	1.725	414.
44	37	5.241	.681	7323.	576.	2.747	7346.	4.497	34.289	.02665	2850.	1000.	5000.	2.132	513.
45	37	5.485	.801	7389.	693.	2.797	7421.	5.360	31.201	.02464	2805.	1000.	5000.	2.731	660.
46	37	5.846	.982	7478.	860.	2.869	7527.	6.557	27.225	.02199	2742.	1000.	5000.	3.691	897.
47	37	6.384	1.261	7594.	1094.	2.973	7672.	8.198	22.389	.01869	2654.	1000.	5000.	5.242	1279.
48	37	6.856	1.514	7680.	1283.	3.058	7787.	9.486	19.044	.01633	2584.	1000.	5000.	6.688	1635.
49	37	7.301	1.759	7751.	1449.	3.134	7885.	10.590	16.486	.01448	2522.	1000.	5000.	8.096	1980.
50	37	7.727	2.000	7810.	1596.	3.203	7971.	11.552	14.468	.01299	2468.	1000.	5000.	9.472	2315.
51	37	8.142	2.240	7860.	1728.	3.266	8047.	12.402	12.837	.01175	2419.	1000.	5000.	10.824	2641.
52	37	8.549	2.479	7903.	1849.	3.325	8116.	13.166	11.486	.01071	2375.	1000.	5000.	12.161	2959.
53	37	8.918	2.718	8021.	1814.	3.419	8224.	12.742	9.604	.00923	2305.	1000.	5000.	13.576	3292.
54	37														
55	37	9.196	2.878	8044.	1880.	3.453	8260.	13.154	9.015	.00876	2281.	1000.	5000.	13.576	3292.
55	37	9.196	2.878	7501.	-199.	2.853	7504.	-1.521	24.649	.01981	2756.	878.	5000.	13.576	3292.
56	37	9.356	2.933	7523.	-142.	2.867	7524.	-1.081	24.007	.01938	2744.	878.	5000.	17.387	4221.
57	37	9.618	3.027	7553.	-62.	2.887	7553.	-.468	23.116	.01878	2727.	878.	5000.	19.217	4664.
58	37	9.803	3.093	7563.	-33.	2.895	7563.	-.247	22.800	.01857	2720.	879.	5000.	20.505	4977.
59	37	9.992	3.162	7575.	0.	2.903	7575.	0.000	22.443	.01833	2713.	879.	5000.	21.831	5300.
34	38	4.160	0.000	7068.	0.	2.572	7068.	0.000	47.551	.03500	3010.	1000.	5000.	0.000	0.
35	38	4.274	.047	6813.	-284.	2.427	6819.	-2.384	62.165	.04376	3147.	1000.	5000.	.016	4.
36	38	4.413	.105	6912.	26.	2.479	6912.	.212	56.410	.04036	3096.	1000.	5000.	.073	17.
37	38	4.538	.163	6981.	153.	2.521	6983.	1.256	52.238	.03786	3057.	1000.	5000.	.150	38.
38	38	4.660	.219	7039.	240.	2.557	7043.	1.953	48.896	.03583	3024.	1000.	5000.	.273	65.
39	38	4.779	.275	7089.	311.	2.589	7096.	2.509	46.068	.03409	2994.	1000.	5000.	.409	97.
40	38	4.898	.331	7135.	374.	2.619	7145.	2.999	43.560	.03254	2966.	1000.	5000.	.566	136.
41	38	5.018	.389	7179.	434.	2.648	7192.	3.459	41.243	.03109	2939.	1000.	5000.	.748	180.
42	38	5.147	.451	7222.	495.	2.678	7239.	3.920	38.994	.02967	2912.	1000.	5000.	.962	232.
43	38	5.293	.522	7269.	562.	2.711	7291.	4.422	36.654	.02818	2882.	1000.	5000.	1.230	297.
44	38	5.475	.611	7324.	643.	2.751	7352.	5.020	34.012	.02648	2846.	1000.	5000.	1.597	387.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
45	38	5.723	.735	7393.	751.	2.804	7431.	5.801	30.813	.02438	2800.	1000.	5000.	2.147	522.
46	38	6.091	.922	7485.	907.	2.878	7540.	6.907	26.761	.02168	2735.	1000.	5000.	3.046	743.
47	38	6.640	1.210	7605.	1130.	2.984	7688.	8.454	21.903	.01835	2645.	1000.	5000.	4.524	1108.
48	38	7.121	1.470	7693.	1313.	3.071	7804.	9.684	18.580	.01600	2573.	1000.	5000.	5.920	1452.
49	38	7.576	1.721	7764.	1473.	3.148	7903.	10.745	16.053	.01416	2511.	1000.	5000.	7.290	1787.
50	38	8.011	1.968	7824.	1617.	3.218	7989.	11.674	14.070	.01269	2457.	1000.	5000.	8.635	2113.
51	38	8.434	2.212	7874.	1745.	3.281	8066.	12.497	12.471	.01147	2408.	1000.	5000.	9.960	2432.
52	38	8.850	2.457	7918.	1863.	3.340	8135.	13.240	11.150	.01045	2363.	1000.	5000.	11.275	2744.
53	38	9.250	2.696	7956.	1965.	3.393	8195.	13.875	10.087	.00961	2324.	1000.	5000.	12.548	3043.
54	38														
55	38	9.447	2.814	7972.	2010.	3.417	8222.	14.148	9.636	.00926	2306.	1000.	5000.	15.069	3659.
55	38	9.447	2.814	7466.	-59.	2.827	7466.	-.452	26.002	.02073	2779.	883.	5000.	15.069	3659.
56	38	9.558	2.856	7480.	-19.	2.837	7480.	-.146	25.509	.02039	2771.	881.	5000.	15.868	3853.
57	38	9.816	2.953	7509.	60.	2.856	7509.	.460	24.535	.01974	2754.	880.	5001.	17.738	4306.
58	38	9.996	3.023	7519.	88.	2.864	7520.	.674	24.183	.01950	2748.	879.	5001.	19.045	4623.
59	38	10.181	3.094	7531.	120.	2.872	7532.	.913	23.788	.01923	2740.	879.	5001.	20.392	4951.
60	38	10.359	3.162	7487.	0.	2.842	7487.	0.000	25.201	.02018	2766.	879.	5000.	21.713	5273.

60 F = 4460.0 FID = 4947.2 ETAF = .9824 ISP = 242.166 ISPID = 244.042 ETAI = .9923

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
35	39	4.370	0.000	6561.	0.	2.285	6561.	0.000	80.344	.05419	3284.	1000.	5000.	0.000	0.
36	39	4.506	.067	6808.	309.	2.424	6815.	2.599	62.452	.04393	3149.	1000.	5000.	.026	6.
37	39	4.626	.129	6911.	361.	2.485	6921.	2.987	55.861	.04003	3091.	1000.	5000.	.093	22.
38	39	4.744	.187	6983.	406.	2.528	6995.	3.330	51.553	.03744	3050.	1000.	5000.	.190	45.
39	39	4.861	.245	7042.	452.	2.565	7056.	3.672	48.173	.03538	3016.	1000.	5000.	.313	75.
40	39	4.977	.304	7093.	498.	2.598	7111.	4.016	45.302	.03362	2985.	1000.	5000.	.459	110.
41	39	5.095	.363	7141.	545.	2.629	7162.	4.368	42.723	.03202	2956.	1000.	5000.	.632	152.
42	39	5.221	.427	7188.	596.	2.661	7212.	4.742	40.267	.03047	2927.	1000.	5000.	.838	202.
43	39	5.365	.500	7237.	654.	2.695	7267.	5.166	37.749	.02888	2896.	1000.	5000.	1.099	266.
44	39	5.545	.591	7294.	727.	2.737	7330.	5.692	34.943	.02708	2859.	1000.	5000.	1.458	354.
45	39	5.790	.718	7365.	826.	2.790	7412.	6.400	31.582	.02489	2811.	1000.	5000.	2.002	487.
46	39	6.153	.908	7460.	973.	2.806	7523.	7.430	27.367	.02209	2745.	1000.	5000.	2.897	708.
47	39	6.696	1.199	7581.	1188.	2.973	7673.	8.903	22.360	.01867	2654.	1000.	5000.	4.378	1073.
48	39	7.172	1.462	7670.	1365.	3.061	7790.	10.039	18.953	.01626	2582.	1000.	5000.	5.782	1418.
49	39	7.622	1.715	7742.	1522.	3.138	7890.	11.119	16.369	.01439	2519.	1000.	5000.	7.167	1756.
50	39	8.052	1.963	7802.	1662.	3.207	7977.	12.025	14.345	.01289	2465.	1000.	5000.	8.518	2085.
51	39	8.471	2.209	7852.	1788.	3.271	8053.	12.831	12.715	.01166	2416.	1000.	5000.	9.856	2407.
52	39	8.882	2.454	7896.	1904.	3.330	8123.	13.559	11.370	.01062	2371.	1000.	5000.	11.182	2722.
53	39														
53	39	9.250	2.696	7956.	1965.	3.393	8195.	13.875	10.087	.00961	2324.	1000.	5000.	12.548	3043.
54	39														
55	39	9.447	2.814	7972.	2010.	3.417	8222.	14.148	9.636	.00926	2306.	1000.	5000.	12.548	3043.
55	39	9.447	2.814	7466.	-59.	2.827	7466.	-.452	26.002	.02073	2779.	883.	5000.	12.548	3043.
56	39	9.558	2.856	7480.	-19.	2.837	7480.	-.146	25.509	.02039	2771.	881.	5000.	15.868	3853.
57	39	9.816	2.953	7509.	60.	2.856	7509.	.460	24.535	.01974	2754.	880.	5001.	17.738	4306.
58	39	9.996	3.023	7519.	88.	2.864	7520.	.674	24.183	.01950	2748.	879.	5001.	19.045	4623.
59	39	10.181	3.094	7531.	120.	2.872	7532.	.913	23.788	.01923	2740.	879.	5001.	20.392	4951.
60	39	10.359	3.162	7487.	0.	2.842	7487.	0.000	25.201	.02018	2766.	879.	5000.	21.713	5273.
36	40	4.669	0.000	7094.	0.	2.588	7094.	0.000	46.153	.03414	2995.	1000.	5000.	0.000	0.
37	40	4.805	.057	7130.	43.	2.610	7130.	.343	44.305	.03300	2974.	1000.	5000.	.017	4.
38	40	4.939	.114	7178.	112.	2.640	7179.	.898	41.862	.03148	2946.	1000.	5000.	.064	15.
39	40	5.069	.170	7224.	176.	2.670	7227.	1.394	39.596	.03005	2919.	1000.	5000.	.136	33.
40	40	5.198	.226	7268.	235.	2.699	7272.	1.850	37.524	.02873	2893.	1000.	5000.	.233	56.
41	40	5.330	.284	7310.	292.	2.727	7316.	2.290	35.576	.02749	2867.	1000.	5000.	.353	86.
42	40	5.470	.346	7352.	352.	2.757	7361.	2.740	33.662	.02625	2841.	1000.	5000.	.505	123.
43	40	5.630	.418	7398.	418.	2.789	7410.	3.235	31.653	.02494	2812.	1000.	5000.	.703	171.

I	J	X	Y	U	V	R	VMAG	THETA	P	RHO	T	PT	VT	MACH	[illegible]
44	40	5.629	.508	7452.	499.	2.829	7469.	5.831	29.378	.02343	2777.	1000.	5000.	.985	248.
45	40	6.101	.633	7521.	687.	2.882	7545.	4.613	26.900	.02156	2732.	1000.	5000.	1.423	348.
46	40	6.585	.823	7613.	763.	2.957	7651.	5.725	23.647	.01914	2667.	1000.	5000.	2.168	582.
47	40	7.129	1.117	7733.	988.	3.065	7756.	7.283	18.794	.01618	2578.	1000.	5000.	3.435	845.
48	40	7.640	1.383	7822.	1172.	3.153	7910.	8.518	15.890	.01404	2507.	1000.	5000.	4.661	1146.
49	40	8.142	1.643	7895.	1333.	3.232	8007.	9.583	13.688	.01240	2445.	1000.	5000.	5.882	1445.
50	40	8.623	1.897	7956.	1477.	3.303	8092.	10.514	11.963	.01108	2391.	1000.	5000.	7.093	1738.
51	40	9.091	2.158	8007.	1606.	3.368	8166.	11.339	10.578	.01000	2343.	1000.	5000.	8.296	2025.
52	40	9.550	2.403	8051.	1724.	3.428	8234.	12.083	9.437	.00910	2298.	1000.	5000.	9.494	2307.
53	40	9.998	2.649	8089.	1829.	3.482	8292.	12.710	8.529	.00836	2260.	1000.	5000.	10.651	2574.
54	40														
55	40	10.024	2.668	8092.	1831.	3.486	8296.	12.752	8.469	.00831	2257.	1000.	5000.	16.392	3980.
55	40	10.024	2.668	7547.	-238.	2.885	7550.	-1.805	23.176	.01882	2728.	878.	5000.	16.392	3980.
56	40														
57	40	10.313	2.766	7582.	-145.	2.908	7583.	-1.098	22.221	.01817	2709.	879.	5001.	18.166	4418.
58	40	10.507	2.835	7593.	-114.	2.915	7594.	-.859	21.914	.01796	2703.	879.	5001.	19.354	4698.
59	40	10.706	2.903	7606.	-79.	2.924	7606.	-.594	21.565	.01772	2696.	879.	5002.	20.583	4997.
60	40	10.876	2.962	7559.	-200.	2.892	7561.	-1.519	22.933	.01865	2725.	879.	5003.	21.656	5259.
61	40	11.449	3.162	7630.	0.	2.942	7630.	0.000	20.844	.01723	2680.	879.	4999.	25.560	6204.
61		F =	4960.0	FID =		4947.2	ETAF =	.9824	ISP =	242.166	ISPID =		244.042	ETAI =	.9923
37	41	4.945	0.000	7165.	0.	2.632	7165.	0.000	42.532	.03190	2954.	1000.	5000.	0.000	0.
38	41	5.083	.057	7221.	70.	2.667	7222.	.558	39.820	.03019	2922.	1000.	5000.	.015	4.
39	41	5.218	.113	7270.	130.	2.698	7271.	1.024	37.545	.02875	2895.	1000.	5000.	.058	14.
40	41	5.352	.170	7314.	186.	2.728	7317.	1.459	35.524	.02745	2867.	1000.	5000.	.126	30.
41	41	5.489	.228	7357.	242.	2.757	7361.	1.885	33.643	.02624	2841.	1000.	5000.	.218	53.
42	41	5.635	.291	7400.	300.	2.787	7406.	2.325	31.803	.02503	2814.	1000.	5000.	.340	85.
43	41	5.800	.363	7446.	366.	2.820	7455.	2.812	29.879	.02377	2785.	1000.	5000.	.506	123.
44	41	6.007	.454	7501.	446.	2.860	7514.	3.400	27.656	.02231	2750.	1000.	5000.	.749	183.
45	41	6.299	.580	7570.	553.	2.913	7590.	4.177	25.042	.02051	2704.	1000.	5000.	1.138	279.
46	41	6.710	.772	7663.	709.	2.990	7696.	5.283	21.670	.01818	2640.	1000.	5000.	1.813	446.
47	41	7.339	1.068	7784.	955.	3.099	7840.	6.836	17.629	.01531	2551.	1000.	5000.	2.987	736.
48	41	7.893	1.330	7874.	1116.	3.188	7953.	8.068	14.877	.01329	2480.	1000.	5000.	4.139	1019.
49	41	8.416	1.601	7948.	1277.	3.268	8049.	9.131	12.795	.01172	2418.	1000.	5000.	5.297	1301.
50	41	8.918	1.860	8006.	1421.	3.339	8134.	10.060	11.168	.01047	2364.	1000.	5000.	6.450	1579.
51	41	9.407	2.116	8060.	1550.	3.405	8208.	10.883	9.865	.00944	2315.	1000.	5000.	7.600	1853.
52	41	9.887	2.373	8105.	1667.	3.466	8275.	11.625	8.790	.00857	2271.	1000.	5000.	8.749	2122.
53	41	10.346	2.623	8143.	1768.	3.520	8333.	12.249	7.938	.00788	2233.	1000.	5000.	9.861	2378.
54	41														
55	41	10.295	2.595	8139.	1755.	3.514	8326.	12.171	8.033	.00795	2238.	1000.	5000.	11.886	2891.
55	41	10.295	2.595	7578.	-313.	2.909	7584.	-2.362	22.104	.01808	2708.	876.	5000.	11.886	2891.
56	41														
57	41	10.543	2.676	7608.	-234.	2.929	7612.	-1.758	21.349	.01757	2692.	877.	5000.	13.295	3233.
58	41	10.743	2.742	7620.	-200.	2.936	7623.	-1.506	21.059	.01737	2686.	878.	5001.	14.433	3509.
59	41	10.948	2.811	7633.	-164.	2.945	7635.	-1.227	20.728	.01714	2678.	878.	5001.	15.612	3796.
60	41	11.114	2.866	7584.	-286.	2.912	7589.	-2.160	22.080	.01807	2708.	879.	5003.	16.585	4033.
61	41	11.712	3.066	7659.	-79.	2.963	7659.	-.593	20.058	.01669	2663.	879.	5001.	20.384	4952.
62	41	11.986	3.162	7686.	0.	2.983	7686.	0.000	19.299	.01616	2645.	879.	4999.	22.075	5364.
62		F =	4860.0	FID =		4947.2	ETAF =	.9824	ISP =	242.166	ISPID =		244.042	ETAI =	.9923
38	42	5.228	0.000	7279.	0.	2.703	7279.	0.000	37.204	.02853	2889.	1000.	5000.	0.000	0.
39	42	5.368	.056	7325.	59.	2.734	7326.	.464	35.147	.02721	2862.	1000.	5000.	.013	3.
40	42	5.508	.113	7369.	116.	2.763	7370.	.904	33.277	.02600	2836.	1000.	5000.	.053	13.
41	42	5.651	.171	7411.	173.	2.791	7413.	1.337	31.520	.02485	2810.	1000.	5000.	.117	28.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
42	42	5.802	.234	7454.	232.	2.821	7457.	1.781	29.795	.02371	2784.	1000.	5000.	.209	51.
43	42	5.975	.306	7500.	298.	2.855	7506.	2.272	27.985	.02250	2755.	1000.	5000.	.343	84.
44	42	6.190	.397	7554.	378.	2.895	7564.	2.865	25.929	.02112	2720.	1000.	5000.	.547	134.
45	42	6.585	.524	7624.	486.	2.949	7639.	3.646	23.426	.01940	2675.	1000.	5000.	.885	217.
46	42	6.924	.717	7717.	642.	3.026	7744.	4.759	20.244	.01718	2610.	1000.	5000.	1.488	366.
47	42	7.581	1.016	7839.	868.	3.135	7887.	6.318	16.433	.01444	2521.	1000.	5000.	2.564	632.
48	42	8.160	1.290	7930.	1051.	3.226	8100.	7.551	13.843	.01252	2450.	1000.	5000.	3.639	896.
49	42	8.708	1.556	8004.	1213.	3.306	8095.	8.615	11.887	.01102	2389.	1000.	5000.	4.728	1161.
50	42	9.234	1.818	8065.	1356.	3.379	8179.	9.545	10.361	.00983	2335.	1000.	5000.	5.821	1424.
51	42	9.745	2.079	8118.	1485.	3.445	8252.	10.368	9.139	.00886	2286.	1000.	5000.	6.915	1683.
52	42	10.248	2.340	8163.	1603.	3.507	8319.	11.109	8.136	.00804	2242.	1000.	5000.	8.012	1939.
53	42														
54	42														
55	42	10.582	2.516	8190.	1671.	3.544	8359.	11.534	7.579	.00758	2216.	1000.	5000.	10.728	2606.
55	42	10.582	2.516	7610.	-397.	2.935	7620.	-2.989	20.998	.01732	2686.	874.	5000.	10.728	2606.
56	42														
57	42	10.784	2.578	7635.	-333.	2.950	7642.	-2.497	20.436	.01694	2673.	875.	5000.	11.781	2861.
58	42	10.991	2.643	7647.	-298.	2.958	7653.	-2.229	20.166	.01675	2667.	877.	5001.	12.866	3124.
59	42	11.203	2.711	7661.	-259.	2.967	7665.	-1.934	19.855	.01654	2660.	877.	5001.	13.993	3398.
60	42	11.365	2.761	7610.	-382.	2.933	7619.	-2.875	21.190	.01746	2689.	878.	5003.	14.866	3611.
61	42	11.991	2.961	7687.	-268.	2.984	7689.	-1.252	19.243	.01611	2646.	879.	5002.	18.549	4502.
62	42	12.277	3.057	7716.	-86.	3.005	7716.	-.637	18.511	.01561	2628.	879.	5000.	20.184	4906.
63	42	12.581	3.162	7746.	0.	3.027	7746.	0.000	17.751	.01507	2609.	879.	4999.	21.925	5325.
63		F =	4860.0	F1D =		4947.2	ETAF = .9824		ISP =	242.166	ISP1D =		244.042	ETAI =	.9923
39	43	5.514	0.000	7372.	0.	2.763	7372.	0.000	33.182	.02594	2834.	1000.	5000.	0.000	0.
40	43	5.659	.057	7416.	57.	2.793	7416.	.440	31.413	.02478	2809.	1000.	5000.	.013	3.
41	43	5.807	.115	7458.	114.	2.822	7459.	.873	29.745	.02368	2783.	1000.	5000.	.050	12.
42	43	5.964	.178	7501.	173.	2.852	7503.	1.318	28.107	.02259	2757.	1000.	5000.	.116	28.
43	43	6.143	.250	7547.	238.	2.886	7551.	1.810	26.387	.02143	2728.	1000.	5000.	.219	54.
44	43	6.367	.341	7602.	319.	2.926	7608.	2.404	24.433	.02010	2693.	1000.	5000.	.387	95.
45	43	6.673	.469	7671.	427.	2.981	7683.	3.186	22.054	.01845	2648.	1000.	5000.	.677	167.
46	43	7.129	.663	7765.	584.	3.058	7787.	4.300	19.031	.01632	2584.	1000.	5000.	1.215	300.
47	43	7.813	.965	7888.	810.	3.169	7930.	5.861	15.414	.01369	2494.	1000.	5000.	2.201	543.
48	43	8.416	1.241	7980.	993.	3.261	8041.	7.095	12.962	.01185	2423.	1000.	5000.	3.205	789.
49	43	8.987	1.511	8054.	1155.	3.342	8136.	8.158	11.114	.01042	2362.	1000.	5000.	4.232	1039.
50	43	9.536	1.777	8116.	1298.	3.415	8219.	9.087	9.675	.00929	2308.	1000.	5000.	5.269	1287.
51	43	10.069	2.041	8169.	1427.	3.482	8293.	9.909	8.524	.00836	2260.	1000.	5000.	6.312	1534.
52	43	10.594	2.306	8214.	1545.	3.544	8358.	10.650	7.581	.00758	2216.	1000.	5000.	7.361	1777.
53	43														
54	43														
55	43	10.853	2.439	8235.	1595.	3.573	8388.	10.964	7.188	.00725	2197.	1000.	5000.	9.542	2313.
55	43	10.853	2.439	7637.	-475.	2.958	7652.	-3.561	20.054	.01666	2667.	871.	5000.	9.542	2313.
56	43														
57	43	11.009	2.485	7656.	-426.	2.970	7668.	-3.181	19.655	.01639	2657	873.	5000.	10.292	2495.
58	43	11.223	2.549	7669.	-388.	2.977	7679.	-2.896	19.404	.01622	2651.	875.	5000.	11.330	2746.
59	43	11.442	2.615	7684.	-347.	2.986	7691.	-2.585	19.111	.01602	2643.	876.	5001.	12.410	3009.
60	43	11.599	2.662	7630.	-471.	2.951	7645.	-3.533	20.432	.01693	2674.	877.	5002.	13.196	3200.
61	43	12.252	2.861	7711.	-249.	3.003	7715.	-1.852	18.551	.01563	2630.	878.	5002.	16.772	4065.
62	43	12.549	2.956	7741.	-164.	3.024	7743.	-1.216	17.843	.01513	2612.	878.	5001.	18.356	4451.
63	43	12.866	3.061	7771.	-76.	3.046	7772.	-.557	17.107	.01461	2593.	879.	5000.	20.044	4862.
64	43	13.162	3.162	7797.	0.	3.066	7797.	0.000	16.483	.01417	2577.	879.	4999.	21.619	5247.
64		F =	4860.0	F1D =		4947.2	ETAF = .9824		ISP =	242.166	ISP1D =		244.042	ETAI =	.9923

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	[illegible]
40	44	5.889	0.000	7468.	0.	2.823	7468.	0.000	28.714	.02366	2783.	1000.	5000.	0.000	0.
41	44	5.962	.058	7502.	57.	2.852	7502.	.432	28.129	.02260	2757.	1000.	5000.	.012	2.
42	44	6.125	.121	7545.	116.	2.882	7546.	.878	26.578	.02155	2731.	1000.	5000.	.051	13.
43	44	6.311	.194	7591.	182.	2.916	7593.	1.378	24.932	.02044	2702.	1000.	5000.	.126	32.
44	44	6.563	.285	7646.	262.	2.957	7650.	1.964	23.070	.01922	2668.	1000.	5000.	.259	64.
45	44	6.861	.413	7716.	378.	3.011	7725.	2.748	20.809	.01758	2622.	1000.	5000.	.503	124.
46	44	7.333	.609	7811.	527.	3.096	7829.	3.863	17.926	.01553	2558.	1000.	5000.	.978	261.
47	44	8.044	.913	7935.	754.	3.202	7970.	5.426	14.487	.01300	2469.	1000.	5000.	1.878	463.
48	44	8.672	1.192	8027.	937.	3.296	8081.	6.659	12.162	.01124	2398.	1000.	5000.	2.812	692.
49	44	9.266	1.464	8102.	1098.	3.376	8176.	7.721	10.413	.00987	2336.	1000.	5000.	3.788	927.
50	44	9.837	1.774	8164.	1242.	3.455	8258.	8.659	9.053	.00879	2283.	1000.	5000.	4.764	1162.
51	44	10.392	2.002	8217.	1371.	3.518	8331.	9.470	7.960	.00790	2235.	1000.	5000.	5.757	1396.
52	44	10.938	2.271	8263.	1488.	3.581	8396.	10.210	7.079	.00716	2191.	1000.	5000.	6.761	1627.
53	44														
54	44														
55	44	11.120	2.361	8277.	1522.	3.600	8416.	10.419	6.829	.00695	2178.	1000.	5000.	8.521	2968.
55	44	11.128	2.361	7662.	-552.	2.979	7682.	-4.120	19.196	.01606	2649.	869.	5000.	8.521	2868.
56	44														
57	44	11.228	2.391	7675.	-517.	2.987	7692.	-3.855	18.941	.01588	2642.	876.	5000.	9.002	2176.
58	44	11.449	2.454	7689.	-477.	2.995	7703.	-3.551	18.708	.01572	2636.	872.	5000.	9.995	2417.
59	44	11.675	2.519	7703.	-434.	3.004	7716.	-3.222	18.455	.01554	2628.	874.	5000.	11.029	2668.
60	44	11.827	2.562	7643.	-559.	2.969	7668.	-4.179	19.742	.01645	2659.	875.	5002.	11.737	2841.
61	44	12.588	2.760	7732.	-329.	3.021	7739.	-2.434	17.925	.01518	2616.	877.	5002.	15.208	3680.
62	44	12.816	2.855	7765.	-241.	3.042	7767.	-1.775	17.240	.01470	2598.	878.	5002.	16.742	4053.
63	44	13.145	2.960	7795.	-149.	3.064	7796.	-1.094	16.526	.01420	2579.	878.	5001.	18.379	4452.
64	44	13.452	3.061	7821.	-71.	3.084	7821.	-.518	15.921	.01376	2562.	879.	5000.	19.905	4825.
65	44	13.753	3.162	7845.	0.	3.103	7845.	0.000	15.375	.01337	2547.	879.	4999.	21.404	5191.

65 F = 4860.0 FID = 4947.2 ETAF = .9824 ISP = 242.166 ISPID = 244.042 ETAI = .9923

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	[illegible]
41	45	6.121	0.000	7544.	0.	2.881	7544.	0.000	26.408	.02158	2732.	1000.	5000.	0.000	0.
42	45	6.290	.063	7587.	59.	2.912	7588.	.445	25.124	.02057	2706.	1000.	5000.	.013	3.
43	45	6.482	.135	7634.	125.	2.946	7635.	.937	23.563	.01950	2677.	1000.	5000.	.059	14.
44	45	6.722	.227	7689.	206.	2.987	7692.	1.532	21.789	.01827	2642.	1000.	5000.	.157	39.
45	45	7.051	.356	7759.	314.	3.042	7766.	2.316	19.630	.01675	2597.	1000.	5000.	.356	88.
46	45	7.542	.552	7855.	471.	3.121	7869.	3.433	16.888	.01477	2535.	1000.	5000.	.768	190.
47	45	8.281	.859	7980.	698.	3.235	8010.	4.996	13.618	.01235	2443.	1000.	5000.	1.583	391.
48	45	8.953	1.141	8072.	881.	3.328	8120.	6.229	11.414	.01066	2373.	1000.	5000.	2.449	603.
49	45	9.551	1.417	8148.	1042.	3.411	8214.	7.290	9.758	.00935	2311.	1000.	5000.	3.358	822.
50	45	10.145	1.689	[illegible]	1186.	3.485	8296.	8.217	8.473	.00831	2258.	1000.	5000.	4.288	1049.
51	45	10.723	1.968	8264.	1314.	3.554	8368.	9.037	7.449	.00747	2210.	1000.	5000.	5.234	1265.
52	45	11.292	2.233	8311.	1432.	3.617	8433.	9.776	6.612	.00676	2166.	1000.	5000.	6.192	1484.
53	45														
54	45														
55	45	11.389	2.280	8316.	1439.	3.627	8440.	9.883	6.489	.00666	2159.	1000.	5000.	7.596	1830.
55	45	11.389	2.280	7684.	-629.	3.008	7710.	-4.682	18.392	.01548	2631.	866.	5000.	7.596	1830.
56	45														
57	45	11.447	2.295	7691.	-611.	3.004	7715.	-4.542	18.268	.01540	2628.	867.	5000.	7.831	1887.
58	45	11.674	2.356	7705.	-568.	3.012	7726.	-4.217	18.054	.01526	2622.	869.	5000.	8.780	2117.
59	45	11.908	2.420	7721.	-522.	3.021	7738.	-3.868	17.797	.01508	2614.	872.	5000.	9.769	2357.
60	45	12.055	2.460	7663.	-658.	2.985	7690.	-4.832	19.095	.01599	2645.	873.	5002.	10.403	2512.
61	45	12.764	2.656	7751.	-409.	3.037	7762.	-3.018	17.342	.01477	2602.	876.	5002.	13.769	3325.
62	45	13.085	2.751	7783.	-317.	3.059	7789.	-2.333	16.600	.01436	2584.	877.	5002.	15.254	3686.
63	45	13.427	2.856	7816.	-222.	3.081	7819.	-1.627	15.987	.01381	2565.	878.	5001.	16.839	4072.
64	45	13.745	2.956	7843.	-141.	3.102	7844.	-1.031	15.399	.01338	2549.	878.	5001.	18.317	4433.
65	45	14.057	3.058	7867.	-66.	3.120	7868.	-.494	14.869	.01300	2535.	879.	5000.	19.768	4788.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
66	45	14.372	3.262	7890.	0.	3.158	7890.	0.000	14.377	.01265	2519.	879.	4999.	21.237	5147.
46		F =	4860.0	FID =		4947.2	ETAF =	.9824	ISP =	242.166		ISPID =	244.042	ETAI =	.9923
42	46	6.464	0.000	7631.	0.	2.942	7631.	0.000	23.701	.01959	2680.	1000.	5000.	0.000	0.
43	46	6.664	.073	7677.	-66.	2.977	7678.	.492	22.218	.01857	2651.	1000.	5000.	.016	4.
44	46	6.913	.165	7733.	147.	3.018	7734.	1.087	20.530	.01738	2616.	1000.	5000.	.079	19.
45	46	7.255	.294	7804.	255.	3.074	7808.	1.872	18.477	.01592	2571.	1000.	5000.	.231	57.
46	46	7.765	.491	7900.	413.	3.154	7911.	2.990	15.870	.01403	2507.	1000.	5000.	.578	143.
47	46	8.533	.800	8025.	639.	3.269	8051.	4.553	12.768	.01170	2417.	1000.	5000.	1.304	322.
48	46	9.212	1.085	8119.	822.	3.363	8160.	5.784	10.682	.01009	2346.	1000.	5000.	2.100	516.
49	46	9.856	1.363	8195.	984.	3.447	8254.	6.845	9.118	.00884	2285.	1000.	5000.	2.947	721.
50	46	10.475	1.634	8256.	1127.	3.522	8335.	7.771	7.907	.00785	2232.	1000.	5000.	3.823	928.
51	46	11.077	1.914	8312.	1256.	3.591	8407.	8.589	6.944	.00704	2184.	1000.	5000.	4.719	1137.
52	46	11.670	2.190	8359.	1373.	3.655	8471.	9.527	6.157	.00637	2141.	1000.	5000.	5.631	1344.
53	46														
54	46														
55	46	11.674	2.192	8359.	1373.	3.655	8471.	9.331	6.153	.00637	2140.	1000.	5000.	7.827	1884.
55	46	11.674	2.192	7701.	-718.	3.019	7735.	-5.326	17.661	.01496	2616.	861.	5000.	7.827	1884.
56	46														
57	46														
58	46	11.911	2.252	7720.	-666.	3.029	7748.	-4.927	17.411	.01479	2608.	865.	5000.	8.735	2103.
59	46	12.152	2.314	7736.	-616.	3.038	7761.	-4.553	17.175	.01463	2600.	868.	5000.	9.679	2332.
60	46	12.294	2.350	7676.	-743.	3.001	7712.	-5.528	18.463	.01554	2632.	870.	5002.	10.241	2469.
61	46	13.034	2.545	7768.	-473.	3.054	7774.	-3.631	16.777	.01436	2588.	874.	5003.	13.496	3254.
62	46	13.368	2.639	7801.	-397.	3.075	7811.	-2.916	16.138	.01391	2571.	876.	5002.	14.929	3603.
63	46	13.725	2.743	7835.	-298.	3.098	7841.	-2.181	15.466	.01343	2552.	877.	5002.	16.461	3976.
64	46	14.054	2.844	7864.	-214.	3.119	7867.	-1.560	14.897	.01302	2535.	878.	5001.	17.888	4325.
65	46	14.378	2.945	7889.	-138.	3.138	7890.	-1.003	14.381	.01264	2520.	879.	5001.	19.289	4667.
66	46	14.704	3.049	7912.	-68.	3.156	7912.	-.490	13.904	.01230	2505.	879.	5000.	20.707	5014.
67	46	15.048	3.162	7934.	0.	3.174	7934.	0.000	13.444	.01196	2491.	879.	4999.	22.213	5382.
67		F =	4860.0	FID =		4947.2	ETAF =	.9824	ISP =	242.166		ISPID =	244.042	ETAI =	.9923
43	47	6.872	0.000	7725.	0.	3.011	7725.	0.000	20.803	.01758	2622.	1000.	5000.	0.000	0.
44	47	7.131	.092	7781.	81.	3.053	7781.	.595	19.208	.01643	2588.	1000.	5000.	.023	6.
45	47	7.487	.221	7852.	189.	3.110	7854.	1.380	17.267	.01505	2542.	1000.	5000.	.124	31.
46	47	8.019	.420	7949.	347.	3.191	7956.	2.498	14.804	.01324	2478.	1000.	5000.	.399	99.
47	47	8.822	.731	8075.	574.	3.307	8096.	4.063	11.678	.01102	2388.	1000.	5000.	1.027	253.
48	47	9.532	1.019	8170.	757.	3.402	8205.	5.292	9.918	.00948	2318.	1000.	5000.	1.745	428.
49	47	10.205	1.301	8246.	918.	3.487	8297.	6.351	8.452	.00830	2257.	1000.	5000.	2.524	616.
50	47	10.853	1.580	8310.	1061.	3.563	8378.	7.275	7.319	.00736	2203.	1000.	5000.	3.349	808.
51	47	11.484	1.858	8365.	1189.	3.633	8449.	8.092	6.419	.00660	2156.	1000.	5000.	4.180	1002.
52	47	12.106	2.139	8412.	1307.	3.697	8513.	8.829	5.686	.00596	2112.	1000.	5000.	5.041	1196.
53	47														
54	47														
55	47	11.996	2.089	8404.	1285.	3.686	8501.	8.693	5.810	.00607	2120.	1000.	5000.	6.098	1474.
55	47	11.996	2.089	7718.	-819.	3.039	7762.	-6.057	16.903	.01441	2599.	856.	5000.	6.098	1474.
56	47														
57	47														
58	47	12.174	2.131	7732.	-778.	3.046	7771.	-5.744	16.739	.01430	2593.	860.	5000.	6.722	1625.
59	47	12.426	2.192	7750.	-724.	3.055	7784.	-5.338	16.527	.01416	2586.	864.	5000.	7.615	1841.
60	47	12.561	2.224	7687.	-852.	3.017	7734.	-6.324	17.805	.01507	2618.	866.	5002.	8.103	1960.
61	47	13.338	2.416	7784.	-588.	3.071	7806.	-4.321	16.198	.01394	2575.	872.	5003.	11.233	2714.
62	47	13.687	2.509	7819.	-487.	3.092	7834.	-3.567	15.584	.01350	2557.	874.	5002.	12.607	3048.
63	47	14.058	2.613	7854.	-383.	3.116	7864.	-2.795	14.937	.01304	2538.	875.	5002.	14.079	3407.

I	J	X	Y	U	V	R	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
64	47	14.483	2.713	7884.	-295.	3.136	7889.	-2.144	14.386	.01264	2521.	876.	5002.	15.450	3741.
65	47	14.741	2.814	7910.	-216.	3.155	7913.	-1.561	13.887	.01228	2506.	877.	5001.	16.796	4070.
66	47	15.080	2.919	7934.	-142.	3.174	7936.	-1.025	13.424	.01194	2491.	878.	5001.	18.158	4403.
67	47	15.437	3.032	7957.	-71.	3.192	7958.	-.514	12.978	.01161	2477.	879.	5000.	19.605	4757.
68	47	15.841	3.162	7981.	0.	3.211	7981.	0.000	12.525	.01127	2461.	879.	4999.	21.257	5168.
68		F =	4860.0	FID =		4947.2	ETAF = .9824		ISP =	242.166	ISPID =		244.042	ETAI =	.9923
44	48	7.404	0.000	7837.	0.	3.096	7837.	0.000	17.705	.01537	2553.	1000.	5000.	0.000	0.
45	48	7.778	.129	7909.	108.	3.153	7910.	.785	15.894	.01404	2507.	1000.	5000.	.039	10.
46	48	8.338	.329	8007.	266.	3.236	8011.	1.904	13.596	.01233	2443.	1000.	5000.	.227	56.
47	48	9.184	.643	8135.	493.	3.353	8150.	3.468	10.873	.01026	2353.	1000.	5000.	.737	181.
48	48	9.934	.933	8230.	676.	3.450	8258.	4.695	9.058	.00879	2283.	1000.	5000.	1.360	333.
49	48	10.646	1.219	8308.	837.	3.536	8350.	5.752	7.703	.00768	2222.	1000.	5000.	2.058	500.
50	48	11.331	1.502	8372.	980.	3.613	8429.	6.675	6.658	.00680	2169.	1000.	5000.	2.801	674.
51	48	11.998	1.786	8427.	1108.	3.684	8500.	7.490	5.831	.00609	2121.	1000.	5000.	3.574	851.
52	48														
53	48														
54	48														
55	48	12.393	1.956	8456.	1177.	3.723	8538.	7.925	5.418	.00573	2095.	1000.	5000.	5.279	1271.
55	48	12.393	1.956	7734.	-946.	3.062	7792.	-6.973	16.056	.01378	2581.	849.	5000.	5.279	1271.
56	48														
57	48														
58	48	12.496	1.979	7743.	-921.	3.066	7797.	-6.783	15.980	.01373	2578.	851.	5000.	5.596	1348.
59	48	12.760	2.037	7762.	-861.	3.075	7809.	-6.330	15.801	.01362	2570.	857.	5000.	6.428	1549.
60	48	12.886	2.064	7695.	-990.	3.056	7758.	-7.331	17.071	.01453	2603.	859.	5001.	6.833	1647.
61	48	13.711	2.252	7798.	-706.	3.089	7830.	-5.173	15.566	.01347	2560.	867.	5002.	9.807	2362.
62	48	14.079	2.344	7835.	-598.	3.111	7856.	-4.364	14.984	.01306	2542.	870.	5002.	11.110	2679.
63	48	14.472	2.447	7873.	-487.	3.135	7888.	-3.538	14.365	.01261	2523.	873.	5002.	12.508	3019.
64	48	14.835	2.547	7904.	-393.	3.156	7914.	-2.845	13.835	.01223	2506.	874.	5002.	13.810	3337.
65	48	15.190	2.648	7932.	-308.	3.175	7938.	-2.225	13.355	.01188	2491.	876.	5002.	15.089	3650.
66	48	15.546	2.752	7957.	-230.	3.194	7961.	-1.657	12.908	.01155	2476.	877.	5001.	16.383	3966.
67	48	15.919	2.865	7981.	-155.	3.212	7983.	-1.116	12.476	.01123	2461.	877.	5001.	17.758	4302.
68	48	16.341	2.996	8005.	-80.	3.231	8006.	-.573	12.039	.01090	2446.	878.	5000.	19.327	4685.
69	48	16.863	3.162	8031.	0.	3.253	8031.	0.000	11.5[illegible]9	.01055	2429.	879.	4999.	21.305	5168.
69		F =	4860.0	FID =		4947.2	ETAF = .9824		ISP =	242.166	ISPID =		244.042	ETAI =	.9923
45	49	8.178	0.000	7982.	0.	3.212	7982.	0.000	14.223	.01280	2461.	1000.	5000.	0.000	0.
46	49	8.777	.200	8081.	158.	3.296	8083.	1.119	12.129	.01121	2397.	1000.	5000.	.075	18.
47	49	9.685	.517	8211.	385.	3.416	8220.	2.683	9.659	.00927	2307.	1000.	5000.	.429	105.
48	49	10.490	.811	8308.	567.	3.514	8327.	3.905	8.022	.00794	2237.	1000.	5000.	.929	226.
49	49	11.255	1.102	8386.	728.	3.602	8418.	4.960	6.804	.00693	2177.	1000.	5000.	1.519	367.
50	49	11.992	1.390	8452.	871.	3.681	8496.	5.881	5.868	.00612	2123.	1000.	5000.	2.166	517.
51	49	12.711	1.679	8507.	999.	3.752	8566.	6.694	5.129	.00547	2076.	1000.	5000.	2.851	672.
52	49														
53	49														
54	49														
55	49	12.930	1.768	8523.	1034.	3.773	8585.	6.915	4.936	.00530	2063.	1000.	5000.	5.355	1286.
55	49	12.930	1.768	7745.	-1124.	3.088	7826.	-8.257	15.071	.01304	2560.	837.	5000.	5.355	1286.
56	49														
57	49														
58	49														
59	49	13.204	1.821	7766.	-1054.	3.097	7838.	-7.730	14.942	.01297	2552.	844.	5000.	6.083	1462.
60	49	13.317	1.842	7694.	-1185.	3.056	7785.	-8.754	16.207	.01388	2586.	847.	5001.	6.391	1537.
61	49	14.212	2.023	7807.	-866.	3.109	7855.	-6.330	14.858	.01294	2544.	860.	5002.	9.153	2199.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
62	49	14.689	2.113	7848.	-745.	3.131	7883.	-5.426	14.321	.01256	2526.	864.	5002.	10.360	2491.
63	49	15.051	2.215	7889.	-623.	3.155	7914.	-4.512	13.739	.01214	2507.	868.	5002.	11.659	2807.
64	49	15.420	2.314	7923.	-519.	3.177	7940.	-3.748	13.237	.01178	2490.	870.	5002.	12.870	3103.
65	49	15.799	2.415	7953.	-426.	3.196	7965.	-3.068	12.777	.01144	2474.	872.	5002.	14.059	3393.
66	49	16.178	2.519	7980.	-341.	3.215	7988.	-2.448	12.348	.01112	2459.	874.	5002.	15.264	3687.
67	49	16.575	2.632	8006.	-260.	3.234	8010.	-1.859	11.933	.01081	2444.	875.	5001.	16.544	4000.
68	49	17.021	2.764	8032.	-178.	3.254	8034.	-1.272	11.511	.01050	2429.	876.	5001.	18.007	4358.
69	49	17.473	2.938	8059.	-92.	3.276	8059.	-.654	11.058	.01016	2412.	878.	5000.	19.848	4807.
70	49	18.312	3.162	8088.	0.	3.301	8088.	0.000	10.567	.00978	2393.	879.	4999.	22.416	5433.
73		F =	4868.0	F10 =		4947.2	ETAF = .9824		ISP =	242.166	ISP10 =	244.042		ETAT = .9923	
46	50	9.437	0.000	8184.	0.	3.383	8184.	0.000	10.272	.00976	2331.	1000.	5000.	0.000	0.
47	50	10.439	.320	8316.	227.	3.507	8319.	1.564	8.135	.00804	2242.	1000.	5000.	.136	33.
48	50	11.330	.618	8414.	408.	3.607	8423.	2.778	6.731	.00686	2173.	1000.	5000.	.462	111.
49	50	12.179	.913	8494.	569.	3.697	8513.	3.832	5.688	.00597	2113.	1000.	5000.	.901	215.
50	50	12.997	1.238	8560.	711.	3.778	8590.	4.751	4.890	.00526	2060.	1000.	5000.	1.413	332.
51	50	13.796	1.505	8617.	839.	3.852	8658.	5.563	4.262	.00469	2013.	1000.	5000.	1.975	456.
52	50														
53	50														
54	50														
55	50	13.713	1.473	8610.	821.	3.842	8649.	5.447	4.335	.00476	2019.	1000.	5000.	3.680	888.
55	50	13.713	1.473	7736.	-1399.	3.116	7862.	-10.252	13.933	.01217	2537.	816.	5000.	3.680	888.
56	50														
57	50														
58	50														
59	50	13.833	1.491	7747.	-1365.	3.119	7866.	-9.975	13.922	.01217	2535.	821.	5000.	3.924	946.
60	50	13.927	1.505	7655.	-1495.	3.075	7810.	-11.039	15.197	.01310	2571.	824.	5001.	4.118	993.
61	50	14.937	1.670	7797.	-1100.	3.125	7874.	-8.033	14.159	.01239	2531.	844.	5002.	6.566	1576.
62	50	15.380	1.757	7865.	-955.	3.165	7902.	-6.929	13.698	.01207	2513.	851.	5002.	7.632	1834.
63	50	15.848	1.858	7892.	-806.	3.171	7933.	-5.832	13.171	.01170	2494.	857.	5002.	8.787	2114.
64	50	16.278	1.956	7931.	-684.	3.193	7960.	-4.926	12.702	.01136	2477.	861.	5002.	9.866	2377.
65	50	16.693	2.057	7965.	-575.	3.215	7985.	-4.150	12.266	.01104	2461.	865.	5002.	10.930	2636.
66	50	17.107	2.165	7995.	-477.	3.233	8009.	-3.411	11.852	.01074	2446.	867.	5002.	12.009	2899.
67	50	17.557	2.277	8024.	-383.	3.253	8033.	-2.736	11.449	.01044	2430.	870.	5002.	13.157	3180.
68	50	18.018	2.420	8052.	-291.	3.273	8057.	-2.068	11.036	.01013	2414.	872.	5001.	14.472	3501.
69	50	18.606	2.579	8082.	-195.	3.296	8084.	-1.371	10.592	.00979	2397.	874.	5001.	16.129	3905.
70	50	19.323	2.812	8113.	-91.	3.322	8114.	-.641	10.112	.00943	2377.	876.	5000.	18.438	4468.
71	50	19.664	3.048	8096.	-30.	3.308	8096.	-.209	10.419	.00967	2388.	878.	5000.	18.438	4468.
71	50	19.925	3.162	8106.	0.	3.316	8106.	0.000	10.265	.00955	2381.	879.	4999.	19.683	4772.
71		F =	4868.0	F10 =		4947.2	ETAF = .9824		ISP =	242.166	ISP10 =	244.042		ETAT = .9923	

PROPERTIES ALONG THE NOZZLE WALL CONTOUR.

I	X	Y	P	F(1-D)	F(2-D)	ETA(F)	ISP(1-D)	ISP(2-D)	ETA(I)
11	0.00000	1.00000	444.242	3835.	3832.	.9940	190.176	190.942	1.0040
12	.00017	1.00000	424.910	3889.	3832.	1.0060	187.858	190.942	1.0162
13	.00035	1.00001	406.852	3889.	3832.	1.0060	187.899	190.943	1.0162
14	.00052	1.00001	389.830	3889.	3832.	1.0060	187.900	190.943	1.0162
15	.00070	1.00002	373.685	3889.	3832.	1.0060	187.902	190.945	1.0162
16	.00087	1.00004	358.305	3889.	3832.	1.0060	187.904	190.946	1.0162
17	.00105	1.00005	343.606	3889.	3832.	1.0060	187.907	190.948	1.0162
18	.00122	1.00007	329.525	3889.	3832.	1.0060	187.911	190.950	1.0162
19	.00139	1.00010	316.011	3889.	3832.	1.0060	187.914	190.952	1.0162
20	.00156	1.00012	303.024	3889.	3832.	1.0060	187.919	190.953	1.0162
21	.00174	1.00015	290.529	3810.	3832.	1.0060	187.923	190.957	1.0161
22	.00191	1.00018	278.499	3810.	3832.	1.0060	187.929	190.960	1.0161
23	.00208	1.00022	266.909	3810.	3832.	1.0060	187.934	190.963	1.0162
24	.00225	1.00026	255.739	3810.	3832.	1.0059	187.940	190.965	1.0161
25	.00242	1.00030	244.969	3810.	3833.	1.0059	187.947	190.968	1.0161
26	.00259	1.00034	234.583	3810.	3833.	1.0059	187.954	190.972	1.0161
27	.15256	1.04053	236.064	3919.	3889.	.9925	193.310	193.804	1.0026
28	.29176	1.07782	233.036	4001.	3944.	.9858	197.365	196.523	.9957
29	.42175	1.11266	226.856	4068.	3996.	.9821	200.688	199.093	.9921
30	.54538	1.14578	218.612	4126.	4044.	.9802	203.534	201.529	.9901
31	.66437	1.17766	209.133	4177.	4091.	.9794	206.040	203.830	.9893
32	.77974	1.20858	199.051	4222.	4135.	.9793	208.284	206.024	.9892
33	.89202	1.23866	188.755	4263.	4176.	.9795	210.315	208.089	.9894
34	1.00140	1.26797	178.617	4301.	4215.	.9800	212.166	210.031	.9899
35	1.10799	1.29653	168.823	4335.	4252.	.9807	213.861	211.854	.9906
36	1.21195	1.32439	159.490	4367.	4286.	.9815	215.421	213.562	.9914
37	1.31227	1.35127	150.793	4395.	4318.	.9822	216.846	215.142	.9921
38	1.41220	1.37805	142.464	4423.	4348.	.9830	218.194	216.651	.9929
39	1.51136	1.40461	134.581	4449.	4377.	.9838	219.465	218.084	.9937
40	1.61123	1.43137	127.047	4474.	4404.	.9845	220.689	219.463	.9945
41	1.71427	1.45899	119.707	4498.	4432.	.9853	221.882	220.820	.9952
42	1.82531	1.48874	112.289	4523.	4460.	.9860	223.109	222.211	.9960
43	1.95376	1.52316	104.325	4550.	4490.	.9868	224.452	223.729	.9968
44	2.11718	1.56692	95.102	4582.	4526.	.9877	226.049	225.527	.9977
45	2.34641	1.62837	83.710	4624.	4572.	.9888	228.105	227.820	.9988
46	2.70042	1.72322	69.143	4681.	4634.	.9899	230.901	230.882	.9999
47	3.26681	1.87499	51.830	4755.	4712.	.9908	234.582	234.765	1.0008
48	3.81419	2.02166	40.275	4812.	4767.	.9907	237.386	237.551	1.0007
49	4.37731	2.17254	31.629	4858.	4810.	.9900	239.642	239.651	1.0000
50	4.96412	2.32978	25.502	4894.	4840.	.9890	241.429	241.187	.9990
51	5.58177	2.49528	20.663	4922.	4861.	.9877	242.782	242.225	.9977
52	6.23499	2.67031	16.893	4940.	4873.	.9863	243.707	242.794	.9963
53	6.91778	2.85326	13.997	4950.	4875.	.9848	244.191	242.905	.9947
54	7.63905	3.04652	11.678	4951.	4868.	.9833	244.229	242.566	.9932
55	8.07105	3.16228	10.619	4947.	4860.	.9824	244.042	242.166	.9923
55	8.07105	3.16228	28.970	4947.	4860.	.9824	244.042	242.166	.9923
56	8.76419	3.16228	25.646	4947.	4860.	.9824	244.042	242.166	.9923
57	9.25639	3.16228	23.807	4947.	4860.	.9824	244.042	242.166	.9923
58	9.61793	3.16228	23.162	4947.	4860.	.9824	244.042	242.166	.9923
59	9.99188	3.16228	22.443	4947.	4860.	.9824	244.042	242.166	.9923
60	10.35857	3.16228	25.201	4947.	4860.	.9824	244.042	242.166	.9923
61	11.44329	3.16228	20.844	4947.	4860.	.9824	244.042	242.166	.9923
62	11.98568	3.16228	19.299	4947.	4860.	.9824	244.042	242.166	.9923
63	12.58121	3.16228	17.751	4947.	4860.	.9824	244.042	242.166	.9923

I	X	Y	P	F(1-D)	F(2-D)	ETA(F)	ISP(1-D)	ISP(2-D)	ETA(I)
64	13.16189	3.16228	16.483	4947.	4860.	.9824	244.042	242.166	.9923
65	13.75321	3.16228	15.375	4947.	4860.	.9824	244.042	242.166	.9923
66	14.37168	3.16229	14.377	4947.	4860.	.9824	244.042	242.166	.9923
67	15.04764	3.16228	13.444	4947.	4860.	.9824	244.042	242.166	.9923
68	15.79854	3.16228	12.525	4947.	4860.	.9824	244.042	242.166	.9923
69	16.46258	3.16228	11.669	4947.	4860.	.9824	244.042	242.166	.9923
70	18.51153	3.16228	10.567	4947.	4860.	.9824	244.042	242.166	.9923
71	19.02558	3.16228	10.265	4947.	4860.	.9824	244.042	242.166	.9923

PERFORMANCE OF THE SCARFED EXTENSION

I	X	Y	Φ	PSI	DFX	ISPX	DFY	ISPY	ISP
55	8.491	3.162	26.970	0.000	0.	242.166	0.	0.000	242.166
56	8.764	3.162	25.646	29.138	0.	242.166	-.1391E+02	.695	242.166
57	9.256	3.162	23.807	38.418	0.	242.166	-.1736E+02	1.558	242.166
58	9.618	3.162	23.162	44.145	0.	242.166	-.1326E+02	2.218	242.166
59	9.992	3.162	22.443	49.511	0.	242.166	-.1398E+02	2.915	242.166
60	9.992	3.162	22.443	49.511	0.	242.166	0.	2.915	242.166
61	9.992	3.162	22.443	49.511	0.	242.166	0.	2.915	242.166
62	9.992	3.162	22.443	49.511	0.	242.166	0.	2.915	242.166
63	10.359	3.162	25.281	54.383	0.	242.166	-.1667E+02	3.746	242.166
64	10.359	3.162	25.281	54.383	0.	242.166	0.	3.746	242.166
65	11.692	3.162	20.644	67.467	0.	242.166	-.5020E+02	6.247	242.166
66	11.986	3.162	19.299	73.428	0.	242.166	-.1718E+02	7.105	242.166
67	12.581	3.162	17.751	79.831	0.	242.166	-.1403E+02	7.802	242.166
68	13.162	3.162	16.483	85.955	0.	242.166	-.8823E+01	8.242	242.166
69	13.797	3.162	15.375	92.144	0.	242.166	-.4611E+01	8.472	242.166
70	14.372	3.162	14.377	98.645	0.	242.166	-.7004E+00	8.507	242.166
71	15.088	3.162	13.444	105.887	0.	242.166	.3281E+01	8.343	242.166
72	15.841	3.162	12.525	119.741	0.	242.166	.6048E+01	7.942	242.166
73	16.863	3.162	11.569	127.276	0.	242.166	.1468E+02	7.211	242.166
74	18.512	3.162	10.567	150.418	0.	242.166	.2189E+02	6.120	242.166
75	19.025	3.162	10.265	180.000	0.	242.166	.4934E+01	5.874	242.166

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SUMMARY OF OVERALL SCARFED NOZZLE PERFORMANCE PARAMETERS

   WDOT  =   .2[illegible]E+ 2 LBM/SEC

   FXN   =   .[illegible]E+[illegible] LBF      ISPXN    =  292.166 (LBF-SEC)/LBM

   FYN   =   .[illegible]E+0[illegible] LBF     ISPYN    =    5.874 (LBF-SEC)/LBM
SUMMARY OF OVERALL MISSILE PERFORMANCE PARAMETERS

   FXM   =   .[illegible]E+04 LBF      ISPXM    =  266.7[illegible]5 (LBF-SEC)/LBM

   FYM   =   .[illegible]E+04 LBF      ISPYM    =  12[illegible].17[illegible] (LBF-SEC)/LBM

   ETA   =   .8[illegible]                  BETAEFF  =  [illegible]1.[illegible]62 DEG
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APPENDIX E

OUTPUT FOR SAMPLE CASE NO. 9

ROTATIONAL FLOWFIELD ALONG LEFT-RUNNING CHARACTERISTICS THAT PASS THROUGH THE OBLIQUE SHOCK WAVE.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	RDOT	F
55	30	8.071	3.162	7886.	2113.	3.366	8164.	15.000	10.519	.01004	2344.	1000.	5000.	12.110	2929.
55	30	8.071	3.162	7649.	669.	2.977	7679.	5.000	21.267	.01778	2651.	958.	5000.	12.110	2929.
26	31	2.819	.241	751?.	606.	2.873	7536.	4.612	26.920	.02179	2737.	1000.	5000.	.194	49.
55	31	8.530	3.085	7966.	2012.	3.412	8216.	14.176	9.734	.00933	2310.	1000.	5000.	18.908	4581.
55	31	8.530	3.085	7716.	573.	3.021	7738.	4.246	19.556	.01658	2614.	958.	5000.	18.908	4581.
56	31	8.861	3.231	7752.	678.	3.054	7782.	5.000	18.379	.01574	2587.	958.	5000.	19.576	4751.
26	32	2.968	.198	7614.	488.	2.942	7630.	3.670	23.734	.01962	2680.	1000.	5000.	.114	29.
55	32	8.845	3.030	8013.	1951.	3.441	8248.	13.684	9.217	.00892	2289.	1000.	5000.	19.871	4825.
55	32	8.845	3.030	7757.	515.	3.048	7774.	3.801	18.565	.01587	2592.	957.	5000.	19.871	4825.
57	32	9.426	3.281	7815.	684.	3.102	7844.	5.000	16.777	.01459	2548.	958.	5000.	22.275	5662.
26	33	3.120	.153	7712.	369.	3.008	7721.	2.738	20.924	.01766	2625.	1000.	5000.	.054	15.
55	33	9.077	2.988	8032.	1934.	3.454	8262.	13.537	8.998	.00874	2280.	1000.	5000.	18.366	4455.
55	33	9.077	2.988	7775.	501.	3.061	7791.	3.686	18.127	.01556	2581.	957.	5000.	18.366	4455.
58	33	9.841	3.327	7840.	686.	3.123	7870.	5.000	16.144	.01413	2531.	958.	5000.	22.676	5515.
26	34	3.278	.105	7805.	248.	3.075	7809.	1.817	18.442	.01590	2570.	1000.	5000.	.014	5.
55	34	9.313	2.945	8053.	1911.	3.467	8277.	13.347	8.767	.00855	2270.	1000.	5000.	16.105	3917.
55	34	9.313	2.945	7794.	482.	3.075	7809.	3.538	17.656	.01522	2570.	957.	5000.	16.105	3917.
59	34	10.271	3.355	7869.	688.	3.145	7899.	5.000	15.462	.01363	2513.	958.	5000.	21.308	5196.
26	35	3.440	.054	7894.	125.	3.142	7895.	.904	16.245	.01430	2516.	1000.	5000.	-.009	-1.
51	35														
55	35	9.313	2.945	8053.	1911.	3.467	8277.	13.347	8.767	.00855	2270.	1000.	5000.	14.809	3578.
55	35	9.313	2.945	7794.	482.	3.075	7809.	3.538	17.656	.01522	2570.	957.	5000.	14.809	3578.
59	35	10.271	3.355	7869.	688.	3.145	7899.	5.000	15.462	.01363	2513.	958.	5000.	21.308	5196.
26	36	3.609	0.000	7979.	0.	3.209	7979.	0.000	14.294	.01286	2463.	1000.	5000.	-.017	-3.
53	36														
55	36	9.313	2.945	8053.	1911.	3.467	8277.	13.347	8.767	.00855	2270.	1000.	5000.	14.809	3578.
55	36	9.313	2.945	7794.	482.	3.075	7809.	3.538	17.656	.01522	2570.	957.	5000.	14.809	3578.
59	36	10.271	3.355	7869.	688.	3.145	7899.	5.000	15.462	.01363	2513.	958.	5000.	21.308	5196.
33	37	3.859	0.000	5743.	0.	1.888	5743.	0.000	160.410	.09642	3686.	1000.	5000.	0.000	0.
35	37														
55	37	9.313	2.945	8053.	1911.	3.467	8277.	13.347	8.767	.00855	2270.	1000.	5000.	14.809	3578.
55	37	9.313	2.945	7794.	482.	3.075	7809.	3.538	17.656	.01522	2570.	957.	5000.	14.809	3578.
59	37	10.271	3.355	7869.	688.	3.145	7899.	5.000	15.462	.01363	2513.	958.	5000.	21.308	5196.
34	38	4.168	0.000	7068.	0.	2.572	7068.	0.000	47.551	.03500	3010.	1000.	5000.	0.000	0.
55	38	9.585	2.898	7984.	2044.	3.435	8241.	14.360	9.319	.00900	2294.	1000.	5000.	15.019	3651.
55	38	9.585	2.898	7749.	623.	3.048	7774.	4.598	18.604	.01590	2592.	959.	5000.	15.019	3651.
60	38	10.674	3.390	7794.	682.	3.096	7823.	5.000	17.303	.01497	2561.	958.	5000.	21.217	5175.
35	39	4.370	0.000	6561.	0.	2.285	6561.	0.000	80.344	.05419	3284.	1000.	5000.	0.000	0.
53	39														
55	39	9.585	2.898	7984.	2044.	3.435	8241.	14.360	9.319	.00900	2294.	1000.	5000.	12.548	3043.
55	39	9.585	2.898	7749.	623.	3.048	7774.	4.598	18.604	.01590	2592.	959.	5000.	12.548	3043.
60	39	10.674	3.390	7794.	682.	3.096	7823.	5.000	17.303	.01497	2561.	958.	5000.	21.217	5175.
36	40	4.669	0.000	7094.	0.	2.598	7094.	0.000	46.153	.03414	2995.	1000.	5000.	0.000	0.
55	40	10.233	2.786	8108.	1876.	3.510	8322.	13.025	8.092	.00800	2240.	1000.	5000.	14.270	3464.
55	40	10.233	2.786	7851.	457.	3.117	7864.	3.333	16.290	.01423	2536.	957.	5000.	14.270	3464.
61	40	11.953	3.502	7946.	695.	3.208	7977.	5.000	13.731	.01235	2463.	959.	4999.	22.860	5573.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
37	41	4.665	0.000	7165.	0.	2.652	7165.	0.000	42.532	.03190	2994.	1000.	5000.	0.000	0.
55	41	10.538	2.732	8198.	-1807.	3.541	8355.	12.488	7.624	.00761	2218.	1000.	5000.	11.542	2793.
55	41	10.538	2.730	7891.	389.	3.146	7901.	2.819	15.409	.02359	2513.	957.	5000.	11.542	2793.
62	41	12.586	3.557	8008.	701.	3.260	8039.	5.000	12.458	.02139	2424.	959.	4999.	21.112	5140.
38	42	5.228	0.000	7279.	0.	2.703	7279.	0.000	37.204	.02853	2889.	1000.	5000.	0.000	0.
55	42	10.865	2.667	8211.	1729.	3.576	8391.	11.894	7.142	.00721	2194.	1000.	5000.	10.528	2541.
55	42	10.865	2.667	7934.	311.	3.178	7940.	2.243	14.505	.01292	2488.	956.	5000.	10.528	2541.
63	42	13.295	3.619	8075.	706.	3.316	8105.	5.000	11.195	.01042	2381.	959.	4999.	21.073	5124.
39	43	5.514	0.000	7372.	0.	2.764	7372.	0.000	33.182	.02594	2834.	1000.	5000.	0.000	0.
55	43	11.175	2.605	8259.	1668.	3.608	8424.	11.363	6.729	.00686	2173.	1000.	5000.	9.499	2284.
55	43	11.175	2.605	7971.	240.	3.206	7975.	1.721	13.734	.01234	2466.	955.	5000.	9.499	2284.
64	43	13.993	3.680	8135.	712.	3.367	8164.	5.000	10.160	.00961	2345.	959.	4999.	20.900	5673.
40	44	5.809	0.000	7460.	0.	2.823	7460.	0.000	29.714	.02366	2783.	1000.	5000.	0.000	0.
55	44	11.481	2.542	8303.	1592.	3.638	8454.	10.855	6.353	.00654	2152.	1000.	5000.	9.983	2402.
55	44	11.481	2.542	8005.	166.	3.232	8007.	1.202	13.045	.01182	2445.	954.	5000.	9.983	2402.
65	44	14.708	3.743	8198.	716.	3.417	8220.	5.000	9.352	.00889	2306.	959.	4999.	22.166	5375.
41	45	6.121	0.000	7544.	0.	2.881	7544.	0.000	26.608	.02158	2732.	1000.	5000.	0.000	0.
55	45	11.792	2.476	8346.	1523.	3.668	8484.	10.343	6.004	.00624	2132.	1000.	5000.	8.184	1977.
55	45	11.792	2.476	8038.	96.	3.258	8039.	.682	12.400	.01133	2425.	953.	5000.	8.184	1977.
66	45	15.461	3.809	8242.	721.	3.466	8274.	5.000	8.632	.00823	2271.	959.	4999.	21.104	5123.
42	46	6.464	0.000	7631.	0.	2.942	7631.	0.000	23.701	.01959	2680.	1000.	5000.	0.000	0.
55	46	12.122	2.404	8390.	1451.	3.700	8515.	9.815	5.660	.00594	2111.	1000.	5000.	7.413	1784.
55	46	12.122	2.404	8071.	19.	3.285	8071.	.138	11.158	.01084	2405.	951.	5000.	7.413	1784.
67	46	16.290	3.881	8296.	726.	3.517	8328.	5.000	7.660	.00759	2255.	959.	4999.	21.061	5098.
43	47	6.872	0.000	7725.	0.	3.011	7725.	0.000	20.605	.01758	2622.	1000.	5000.	0.000	0.
55	47	12.497	2.318	8438.	1371.	3.735	8549.	9.230	5.300	.00562	2088.	1000.	5000.	6.667	1598.
55	47	12.497	2.318	8103.	-67.	3.315	8105.	-.475	11.109	.01033	2382.	950.	5000.	6.667	1598.
68	47	17.274	3.967	8355.	731.	3.573	8387.	5.000	6.988	.00695	2196.	959.	4998.	21.079	5084.
44	48	7.484	0.000	7837.	0.	3.096	7837.	0.000	17.705	.01537	2553.	1000.	5000.	0.000	0.
55	48	12.965	2.207	8495.	1273.	3.778	8590.	8.525	4.891	.00526	2060.	1000.	5000.	5.901	1406.
55	48	12.965	2.207	8144.	-175.	3.350	8146.	-1.235	10.367	.00975	2356.	947.	5000.	5.901	1406.
69	48	18.560	4.080	8424.	737.	3.641	8456.	5.000	6.061	.00625	2159.	959.	4998.	21.180	5081.
45	49	8.178	0.000	7982.	0.	3.212	7982.	0.000	14.223	.01280	2461.	1000.	5000.	0.000	0.
55	49	13.605	2.048	8567.	1142.	3.835	8643.	7.591	4.395	.00481	2024.	1000.	5000.	5.054	1194.
55	49	13.605	2.048	8191.	-324.	3.395	8197.	-2.266	9.478	.00904	2322.	944.	5000.	5.054	1194.
70	49	20.428	4.245	8510.	745.	3.730	8542.	5.000	5.135	.00544	2090.	959.	4998.	21.380	5085.
46	50	9.437	0.000	8184.	0.	3.363	8184.	0.000	10.272	.00936	2331.	1000.	5000.	0.000	0.
55	50	14.555	1.793	8663.	947.	3.916	8715.	6.238	3.781	.00424	1974.	1000.	5000.	4.103	976.
55	50	14.555	1.793	8241.	-561.	3.452	8260.	-3.895	8.441	.00828	2281.	936.	5000.	4.103	976.
71	50	20.707	4.190	8523.	720.	3.740	8555.	4.828	5.034	.00535	2094.	959.	4999.	18.463	4388.
71	50	20.982	4.292	8531.	746.	3.752	8563.	5.000	4.927	.00526	2076.	959.	4998.	19.158	4547.

PROPERTIES ALONG THE NOZZLE WALL CONTOUR.

I	X	Y	P	F(1-D)	F(2-D)	ETA(F)	ISP(1-D)	ISP(2-D)	ETA(I)
11	0.00000	1.00000	444.242	3855.	3832.	.9940	190.176	190.942	1.0040
12	.00017	1.00000	424.918	3809.	3832.	1.0060	187.898	190.942	1.0162
13	.00035	1.00001	406.852	3809.	3832.	1.0060	187.899	190.943	1.0162
14	.00052	1.00001	389.[illegible]	3809.	3832.	1.0060	187.900	190.943	1.0162
15	.00070	1.00002	373.685	3809.	3832.	1.0060	187.902	190.945	1.0162
16	.00087	1.00004	358.305	3809.	3832.	1.0060	187.904	190.946	1.0162
17	.00105	1.00005	343.606	3809.	3832.	1.0060	187.907	190.948	1.0162
18	.00122	1.00007	329.525	3809.	3832.	1.0060	187.911	190.950	1.0162
19	.00139	1.00010	316.011	3809.	3832.	1.0060	187.914	190.952	1.0162
20	.00156	1.00012	303.024	3809.	3832.	1.0060	187.919	190.955	1.0162
21	.00174	1.00015	290.529	3810.	3832.	1.0060	187.923	190.957	1.0161
22	.00191	1.00018	278.499	3810.	3832.	1.0060	187.929	190.960	1.0161
23	.00208	1.00022	266.903	3810.	3832.	1.0060	187.934	190.963	1.0161
24	.00225	1.00026	255.739	3810.	3832.	1.0059	187.940	190.965	1.0161
25	.00242	1.00030	244.969	3810.	3833.	1.0059	187.947	190.968	1.0161
26	.00259	1.00034	234.583	3810.	3833.	1.0059	187.954	190.972	1.0161
27	.15256	1.04053	236.064	3919.	3889.	.9925	193.310	193.604	1.0026
28	.29376	1.07782	233.036	4001.	3944.	.9858	197.365	196.523	.9957
29	.42175	1.11266	226.856	4068.	3996.	.9821	200.688	199.093	.9921
30	.54538	1.14578	218.612	4126.	4044.	.9802	203.534	201.529	.9901
31	.66437	1.17766	209.133	4177.	4091.	.9794	206.040	203.838	.9893
32	.77974	1.20858	199.031	4222.	4135.	.9793	208.284	206.024	.9892
33	.89202	1.23866	188.755	4263.	4176.	.9795	210.315	208.089	.9894
34	1.00140	1.26797	178.617	4301.	4215.	.9800	212.166	210.031	.9899
35	1.10799	1.29653	168.823	4335.	4252.	.9807	213.861	211.854	.9906
36	1.21195	1.32439	159.490	4367.	4286.	.9815	215.421	213.562	.9914
37	1.31227	1.35127	150.793	4396.	4318.	.9822	216.846	215.142	.9921
38	1.41220	1.37805	142.464	4423.	4348.	.9830	218.194	216.651	.9929
39	1.51136	1.40461	134.581	4449.	4377.	.9838	219.465	218.084	.9937
40	1.61123	1.43137	127.047	4474.	4404.	.9845	220.684	219.463	.9945
41	1.71427	1.45899	119.707	4498.	4432.	.9853	221.882	220.820	.9952
42	1.82531	1.48874	112.289	4523.	4460.	.9860	223.109	222.211	.9960
43	1.95376	1.52316	104.325	4550.	4490.	.9868	224.452	223.729	.9968
44	2.11710	1.56692	95.102	4582.	4526.	.9877	226.049	225.527	.9977
45	2.34641	1.62837	83.710	4624.	4572.	.9888	228.105	227.820	.9988
46	2.70042	1.72322	69.143	4681.	4634.	.9899	230.901	230.882	.9999
47	3.26681	1.87499	51.830	4755.	4712.	.9908	234.582	234.765	1.0008
48	3.81419	2.02166	40.275	4812.	4767.	.9907	237.386	237.551	1.0007
49	4.37731	2.17254	31.829	4858.	4810.	.9900	239.642	239.651	1.0000
50	4.96912	2.32978	25.502	4894.	4840.	.9890	241.429	241.187	.9990
51	5.58177	2.49528	20.663	4922.	4861.	.9877	242.782	242.225	.9977
52	6.23499	2.67031	16.893	4940.	4873.	.9863	243.707	242.794	.9963
53	6.91778	2.85326	13.997	4950.	4875.	.9848	244.191	242.905	.9947
54	7.63905	3.04632	11.678	4951.	4868.	.9833	244.229	242.566	.9932
55	8.07105	3.16228	10.619	4947.	4860.	.9824	244.042	242.166	.9923
55	8.07105	3.16228	21.267	4947.	4860.	.9824	244.042	242.166	.9923
56	8.86126	3.23141	18.379	4943.	4860.	.9831	243.860	242.156	.9930
57	9.42594	3.28082	16.777	4940.	4863.	.9843	243.699	242.300	.9943
58	9.84057	3.31709	16.144	4937.	4864.	.9851	243.565	242.366	.9951
59	10.27092	3.35474	15.462	4934.	4865.	.9859	243.411	242.410	.9959
60	10.67413	3.39002	17.305	4931.	4866.	.9868	243.255	242.473	.9968
61	11.95262	3.50187	13.731	4920.	4858.	.9895	242.680	242.568	.9995
62	12.58686	3.55733	12.458	4913.	4866.	.9905	242.351	242.470	1.0005
63	13.29626	3.61943	11.195	4905.	4862.	.9913	241.949	242.269	1.0013

I	X	Y	P	F(1-D)	F(2-D)	ETA(F)	ISP(1-D)	ISP(2-D)	ETA(I)
64	13.99296	3.64038	7.160	4896.	4856.	.9919	241.522	241.989	1.0019
65	14.70751	3.74289	9.252	4887.	4849.	.9924	241.050	241.626	1.0024
66	15.46050	3.80877	8.432	4876.	4840.	.9927	240.516	241.170	1.0027
67	16.29024	3.88136	7.660	4863.	4828.	.9929	239.886	240.589	1.0029
68	17.27399	3.96789	6.869	4847.	4813.	.9930	239.084	239.804	1.0030
69	18.56043	4.07990	6.061	4824.	4789.	.9929	237.946	238.637	1.0029
70	20.42753	4.24355	5.135	4787.	4750.	.9924	236.121	236.699	1.0024
71	20.98195	4.29384	4.927	4775.	4738.	.9922	235.541	236.073	1.0023

PERFORMANCE OF THE SCARFED EXTENSION

I	X	Y	P	PSI	DFX	ISPX	DFY	ISPY	ISP
55	8.071	3.162	21.267	0.000	0.	242.166	0.	0.000	242.166
56	8.861	3.231	18.375	33.131	-.6465E+01	242.468	-.7386E+01	.368	242.156
57	9.426	3.281	16.777	43.495	-.2295E+01	242.603	-.6571E+01	.695	242.308
58	9.841	3.317	16.144	49.809	-.9832E+00	242.652	-.3511E+01	.870	242.366
59	10.271	3.355	15.462	55.665	-.6176E+00	242.682	-.2530E+01	.996	242.410
60	10.271	3.355	15.462	55.665	0.	242.682	0.	.996	242.410
61	10.271	3.355	15.462	55.665	0.	242.682	0.	.996	242.410
62	10.271	3.355	15.462	55.665	0.	242.682	0.	.996	242.410
63	10.674	3.390	17.303	60.693	-.8552E+00	242.725	-.3897E+01	1.191	242.473
64	10.674	3.390	17.303	60.693	0.	242.725	0.	1.191	242.473
65	11.953	3.502	13.731	74.747	-.1241E+01	242.787	-.6696E+01	1.524	242.568
66	12.536	3.557	12.458	81.019	.1117E+01	242.731	.7007E+01	1.175	242.470
67	13.296	3.619	11.195	87.696	.2135E+01	242.625	.1455E+02	.450	242.269
68	13.993	3.660	10.160	94.000	.2782E+01	242.486	.2043E+02	.568	241.989
69	14.708	3.743	9.252	100.301	.3348E+01	242.319	.2626E+02	1.876	241.626
70	15.461	3.889	8.432	106.850	.3885E+01	242.126	.3236E+02	3.489	241.170
71	16.290	3.881	7.660	114.071	.4506E+01	241.901	.3975E+02	5.470	240.589
72	17.274	3.967	6.868	122.832	.5386E+01	241.633	.5039E+02	7.980	239.804
73	18.560	4.080	6.061	135.175	.6628E+01	241.302	.6614E+02	11.276	238.637
74	20.428	4.243	5.135	159.390	.7063E+01	240.951	.7642E+02	15.084	236.699
	20.982	4.292	4.927	180.000	.7197E+00	240.915	.8181E+01	15.491	236.073

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SUMMARY OF OVERALL SCARFED NOZZLE PERFORMANCE PARAMETERS

    WDOT   =    .2006917E+02 LBM/SEC

    FXN    =   -.4834493E+04 LBF      ISPXN    =  240.915 (LBF-SEC)/LBM

    FYN    =    .3108937E+03 LBF      ISPYN    =   15.491 (LBF-SEC)/LBM
SUMMARY OF OVERALL MISSILE PERFORMANCE PARAMETERS

    FXM    =   -.4342628E+04 LBF      ISPXM    =  216.384 (LBF-SEC)/LBM

    FYM    =   -.2148226E+04 LBF      ISPYM    =  107.041 (LBF-SEC)/LBM

    CTA    =    .9151                 BETAEFF  =   29.773 DEG
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APPENDIX F

OUTPUT FOR SAMPLE CASE NO. 10

ROTATIONAL FLOWFIELD ALONG LEFT-RUNNING CHARACTERISTICS THAT PASS THROUGH THE OBLIQUE SHOCK WAVE.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
55	30	8.071	3.162	7886.	2113.	3.366	8164.	15.000	10.619	.01004	2344.	1000.	5000.	12.110	2929.
55	30	8.071	3.162	7886.	2113.	3.366	8164.	15.000	10.619	.01004	2344.	1000.	5000.	12.110	2929.
26	31	3.819	.241	7511.	606.	2.875	7536.	4.612	26.920	.02179	2737.	1000.	5000.	.194	49.
55	31	8.618	3.139	7972.	2033.	3.422	8227.	14.305	9.542	.00918	2303.	1000.	5000.	19.340	4664.
55	31	8.618	3.139	7972.	2033.	3.423	8227.	14.305	9.541	.00918	2303.	1000.	5000.	19.340	4664.
56	31	9.112	3.491	8007.	2146.	3.480	8290.	15.000	8.561	.00839	2261.	1000.	4999.	19.256	4640.
26	32	2.968	.198	7614.	488.	2.942	7630.	3.670	23.734	.01962	2680.	1000.	5000.	.114	29.
55	32	8.998	3.129	8025.	1985.	3.458	8267.	13.896	8.916	.00868	2277.	1000.	5000.	19.218	4633.
55	32	8.998	3.128	8025.	1985.	3.458	8267.	13.897	8.915	.00867	2277.	1000.	5000.	19.218	4633.
57	32	9.868	3.644	8082.	2166.	3.553	8367.	15.000	7.456	.00748	2209.	1001.	4999.	22.113	5283.
26	33	3.120	.153	7712.	349.	3.008	7721.	2.738	20.924	.01766	2625.	1000.	5000.	.054	15.
55	33	9.277	3.106	8047.	1977.	3.476	8286.	13.805	8.620	.00843	2264.	1000.	5000.	18.060	4346.
55	33	9.277	3.106	8047.	1977.	3.476	8286.	13.806	8.619	.00843	2264.	1000.	5000.	18.060	4346.
58	33	10.423	3.793	8119.	2175.	3.590	8405.	15.000	6.961	.00706	2184.	1001.	4999.	21.729	5162.
26	34	3.278	.105	7805.	248.	3.075	7809.	1.817	18.442	.01590	2570.	1000.	5000.	.014	5.
55	34	9.563	3.091	8071.	1965.	3.496	8307.	13.684	8.308	.00818	2250.	1000.	5000.	17.239	4143.
55	34	9.563	3.091	8071.	1965.	3.496	8307.	13.685	8.307	.00818	2250.	1000.	5000.	17.239	4143.
59	34	11.003	3.948	8157.	2186.	3.630	8445.	15.000	6.460	.00663	2157.	1001.	4999.	21.676	5119.
26	35	3.440	.054	7894.	125.	3.142	7895.	.904	16.245	.01430	2516.	1000.	5000.	-.009	-1.
51	35	--------------------													
55	35	9.563	3.091	8071.	1965.	3.496	8307.	13.684	8.308	.00818	2250.	1000.	5000.	14.809	3578.
55	35	9.563	3.091	8071.	1965.	3.496	8307.	13.685	8.307	.00818	2250.	1000.	5000.	14.809	3578.
59	35	11.003	3.948	8157.	2186.	3.630	8445.	15.000	6.460	.00663	2157.	1001.	4999.	21.676	5119.
26	36	3.699	0.000	7979.	0.	3.209	7979.	0.000	14.294	.01286	2463.	1000.	5000.	-.017	-3.
53	36	--------------------													
55	36	9.563	3.091	8071.	1965.	3.496	8307.	13.684	8.308	.00818	2250.	1000.	5000.	14.809	3578.
55	36	9.563	3.091	8071.	1965.	3.496	8307.	13.685	8.307	.00818	2250.	1000.	5000.	14.809	3578.
59	36	11.003	3.948	8157.	2186.	3.630	8445.	15.000	6.460	.00663	2157.	1001.	4999.	21.676	5119.
33	37	3.659	0.000	5743.	0.	1.888	5743.	0.000	160.410	.09642	3686.	1000.	5000.	0.000	0.
35	37	--------------------													
55	37	9.563	3.091	8071.	1965.	3.496	8307.	13.684	8.308	.00818	2250.	1000.	5000.	14.809	3578.
55	37	9.563	3.091	8071.	1965.	3.496	8307.	13.685	8.307	.00818	2250.	1000.	5000.	14.809	3578.
59	37	11.003	3.948	8157.	2186.	3.630	8445.	15.000	6.460	.00663	2157.	1001.	4999.	21.676	5119.
34	38	4.140	0.000	7068.	0.	2.572	7068.	0.000	47.551	.03500	3010.	1000.	5000.	0.000	0.
55	38	9.879	3.078	8006.	2107.	3.470	8279.	14.746	8.729	.00852	2269.	1000.	5000.	16.306	3914.
55	38	9.879	3.078	8006.	2107.	3.470	8279.	14.747	8.728	.00852	2269.	1000.	5000.	16.306	3914.
60	38	11.490	4.078	8103.	2171.	3.574	8389.	15.000	7.173	.00724	2195.	1001.	4999.	21.563	5067.
35	39	4.370	0.000	6561.	0.	2.285	6561.	0.000	80.344	.05419	3284.	1000.	5000.	0.000	0.
53	39	--------------------													
55	39	9.879	3.078	8006.	2107.	3.470	8279.	14.746	8.729	.00852	2269.	1000.	5000.	13.828	3338.
55	39	9.879	3.078	8006.	2107.	3.470	8279.	14.747	8.728	.00852	2269.	1000.	5000.	13.828	3338.
60	39	11.490	4.078	8103.	2171.	3.574	8389.	15.000	7.173	.00724	2195.	1001.	4999.	21.563	5067.
36	40	4.669	0.000	7094.	0.	2.588	7094.	0.000	46.153	.03414	2995.	1000.	5000.	0.000	0.
55	40	10.684	3.044	8140.	1967.	3.560	8375.	13.581	7.363	.00740	2205.	1000.	5000.	15.532	3722.
55	40	10.684	3.044	8140.	1967.	3.560	8375.	13.585	7.361	.00739	2205.	1000.	5000.	15.532	3722.
61	40	13.291	4.561	8272.	2217.	3.743	8564.	15.000	5.131	.00548	2074.	1002.	4997.	22.898	5286.

I	J	X	Y	U	V	W	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
57	41	4.945	0.000	7165.	0.	2.652	7165.	0.000	42.532	.03190	2954.	1000.	5000.	0.000	0.
55	41	11.867	3.825	8195.	1910.	3.598	8414.	13.118	6.846	.00696	2179.	1000.	5000.	13.390	3186.
55	41	11.869	3.825	8195.	1910.	3.599	8415.	13.121	6.844	.00696	2179.	1000.	5000.	13.390	3186.
62	41	14.201	4.805	8352.	2235.	3.832	8637.	15.000	4.435	.00485	2024.	1003.	4997.	21.631	4898.
38	42	5.228	0.000	7279.	0.	2.703	7279.	0.000	37.204	.02853	2889.	1000.	5030.	0.000	0.
55	42	11.486	3.882	8255.	1845.	3.641	8457.	12.601	6.324	.00652	2150.	1000.	5030.	12.502	2963.
55	42	11.486	3.882	8255.	1846.	3.641	8457.	12.605	6.322	.00651	2150.	1000.	5000.	12.502	2963.
63	42	14.741	5.084	8417.	2255.	3.918	8714.	15.000	3.777	.00425	1971.	1003.	4997.	21.620	4804.
39	43	5.514	0.000	7372.	0.	2.764	7372.	0.000	33.182	.02594	2834.	1000.	5000.	0.000	0.
55	43	11.883	2.978	8385.	1786.	3.679	8495.	12.138	5.882	.00615	2124.	1000.	5000.	11.605	2736.
55	43	11.884	2.978	8385.	1787.	3.679	8495.	12.142	5.880	.00613	2124.	1000.	5000.	11.605	2736.
64	43	16.228	5.361	8484.	2273.	3.999	8783.	15.000	3.255	.00375	1923.	1003.	4996.	21.499	4671.
43	44	5.809	0.000	7458.	0.	2.823	7460.	0.000	29.714	.02366	2783.	1000.	5000.	0.000	0.
55	44	12.281	2.951	8354.	1729.	3.717	8532.	11.695	5.483	.00579	2100.	1000.	5000.	10.812	2535.
55	44	12.281	2.951	8354.	1735.	3.717	8532.	11.700	5.481	.00578	2099.	1000.	5000.	10.812	2535.
65	44	17.358	5.651	8547.	2290.	4.078	8848.	15.000	2.815	.00332	1876.	1003.	4996.	21.425	4535.
41	45	6.121	0.000	7544.	0.	2.881	7544.	0.000	26.608	.02158	2732.	1000.	5000.	0.000	0.
55	45	12.689	2.923	8402.	1673.	3.754	8567.	11.258	5.112	.00546	2075.	1000.	5000.	10.076	2349.
55	45	12.689	2.923	8403.	1673.	3.754	8567.	11.262	5.110	.00546	2075.	1000.	5000.	10.076	2349.
66	45	18.515	5.961	8609.	2307.	4.158	8912.	15.000	2.431	.00294	1831.	1003.	4996.	21.376	4386.
42	46	6.464	0.000	7631.	0.	2.962	7631.	0.000	23.701	.01959	2680.	1000.	5000.	0.000	0.
55	46	13.125	2.889	8451.	1613.	3.793	8604.	10.805	4.752	.00514	2050.	1000.	5000.	9.375	2170.
55	46	13.125	2.889	8451.	1614.	3.793	8604.	10.810	4.750	.00513	2050.	1000.	5000.	9.375	2170.
67	46	19.813	6.308	8672.	2324.	4.243	8978.	15.000	2.083	.00259	1784.	1004.	4996.	21.357	4214.
43	47	6.872	0.000	7725.	0.	3.011	7725.	0.000	20.803	.01758	2622.	1000.	5000.	0.000	0.
55	47	13.628	2.849	8505.	1546.	3.837	8644.	10.303	4.380	.00480	2022.	1000.	5000.	8.679	1995.
55	47	13.628	2.849	8505.	1547.	3.837	8644.	10.308	4.378	.00480	2022.	1000.	5000.	8.679	1995.
68	47	21.384	6.729	8740.	2342.	4.359	9049.	15.000	1.749	.00224	1733.	1004.	4996.	21.387	4001.
44	48	7.404	0.000	7837.	0.	3.096	7837.	0.000	17.705	.01537	2553.	1000.	5000.	0.000	0.
55	48	14.264	2.793	8568.	1464.	3.891	8595.	9.695	3.964	.00441	1989.	1000.	5000.	7.943	1806.
55	48	14.268	2.793	8569.	1465.	3.891	8695.	9.700	3.962	.00441	1989.	1000.	5000.	7.943	1806.
69	48	23.493	7.295	8822.	2364.	4.460	9135.	15.000	1.409	.00187	1671.	1005.	4995.	21.488	3699.
45	49	8.178	0.000	7982.	0.	3.212	7982.	0.000	14.223	.01280	2461.	1000.	5000.	0.000	0.
55	49	15.150	2.708	8650.	1355.	3.962	8755.	8.891	3.469	.00395	1945.	1000.	5000.	7.104	1593.
55	49	15.150	2.708	8650.	1354.	3.963	8756.	8.898	3.467	.00395	1945.	1000.	5000.	7.104	1593.
70	49	26.625	8.147	8927.	2392.	4.626	9242.	15.000	1.050	.00146	1590.	1006.	4994.	21.686	3190.
46	50	9.437	0.000	8184.	0.	3.383	8184.	0.000	10.272	.00976	2331.	1000.	5000.	0.000	0.
55	50	16.505	2.564	8762.	1195.	4.066	8843.	7.751	2.864	.00337	1884.	1000.	5000.	6.085	1336.
55	50	16.505	2.564	8762.	1194.	4.067	8843.	7.761	2.862	.00337	1884.	1000.	5000.	6.085	1336.
71	50	27.619	8.182	8970.	2357.	4.665	9270.	14.604	.979	.00138	1574.	1004.	4997.	19.210	2418.
71	50	28.512	8.640	8978.	2406.	4.710	9294.	15.000	.906	.00129	1552.	1007.	4994.	20.260	2381.

PROPERTIES ALONG THE NOZZLE WALL CONTOUR.

I	X	Y	P	F(1-D)	F(2-D)	ETA(F)	ISP(1-D)	ISP(2-D)	ETA(I)
11	0.00000	1.00000	444.242	3855.	3832.	.9940	190.176	198.942	1.0048
12	.00017	1.00000	424.910	3809.	3832.	1.0060	187.898	198.942	1.0162
13	.00035	1.00001	406.852	3809.	3832.	1.0060	187.899	198.943	1.0162
14	.00052	1.00001	389.830	3809.	3832.	1.0060	187.900	198.943	1.0162
15	.00070	1.00002	373.685	3809.	3832.	1.0060	187.902	198.945	1.0162
16	.00087	1.00004	358.305	3809.	3832.	1.0060	187.904	198.946	1.0162
17	.00105	1.00005	343.606	3809.	3832.	1.0060	187.907	198.948	1.0162
18	.00122	1.00007	329.525	3809.	3832.	1.0060	187.911	198.950	1.0162
19	.00139	1.00010	316.011	3809.	3832.	1.0060	187.914	198.952	1.0162
20	.00156	1.00012	303.024	3809.	3832.	1.0060	187.919	198.955	1.0162
21	.00174	1.00015	290.529	3810.	3832.	1.0060	187.923	198.957	1.0161
22	.00191	1.00018	278.499	3810.	3832.	1.0060	187.929	198.960	1.0161
23	.00208	1.00022	266.909	3810.	3832.	1.0060	187.934	198.963	1.0161
24	.00225	1.00026	255.739	3810.	3832.	1.0059	187.940	198.965	1.0161
25	.00242	1.00030	244.969	3810.	3833.	1.0059	187.947	198.968	1.0161
26	.00259	1.00034	234.583	3810.	3833.	1.0059	187.954	198.972	1.0161
27	.15256	1.04053	236.064	3919.	3889.	.9925	193.310	193.804	1.0026
28	.29176	1.07782	233.036	4001.	3944.	.9858	197.365	196.523	.9957
29	.42175	1.11266	226.856	4068.	3996.	.9821	200.688	199.093	.9921
30	.54538	1.14578	218.612	4126.	4044.	.9802	203.534	201.529	.9901
31	.66437	1.17766	209.133	4177.	4091.	.9794	206.040	203.838	.9893
32	.77974	1.20858	199.031	4222.	4135.	.9793	208.284	206.024	.9892
33	.89262	1.23866	188.755	4263.	4176.	.9795	210.315	208.089	.9894
34	1.00140	1.26797	178.617	4301.	4215.	.9800	212.166	210.031	.9899
35	1.10799	1.29653	168.823	4335.	4252.	.9807	213.861	211.854	.9906
36	1.21195	1.32439	159.490	4367.	4286.	.9815	215.421	213.562	.9914
37	1.31227	1.35127	150.743	4396.	4318.	.9822	216.846	215.142	.9921
38	1.41220	1.37805	142.464	4423.	4348.	.9830	218.194	216.651	.9929
39	1.51136	1.40461	134.581	4449.	4377.	.9838	219.465	218.084	.9937
40	1.61123	1.43137	127.047	4474.	4404.	.9845	220.684	219.463	.9945
41	1.71427	1.45899	119.707	4498.	4432.	.9853	221.882	220.820	.9952
42	1.82531	1.48874	112.289	4523.	4460.	.9860	223.109	222.211	.9960
43	1.95376	1.52316	104.325	4550.	4490.	.9868	224.452	223.729	.9968
44	2.11710	1.56692	95.102	4582.	4526.	.9877	226.049	225.527	.9977
45	2.34641	1.62837	83.710	4624.	4572.	.9888	228.105	227.820	.9988
46	2.70042	1.72322	69.143	4681.	4634.	.9899	230.901	230.882	.9999
47	3.26681	1.87499	51.838	4755.	4722.	.9908	234.582	234.765	1.0008
48	3.81419	2.02166	40.275	4812.	4767.	.9907	237.386	237.551	1.0007
49	4.37731	2.17254	31.829	4858.	4810.	.9900	239.642	239.652	1.0000
50	4.96412	2.32978	25.502	4894.	4840.	.9890	241.429	241.187	.9990
51	5.58177	2.49528	20.663	4922.	4861.	.9877	242.782	242.225	.9977
52	6.23499	2.67031	16.893	4940.	4873.	.9863	243.707	242.794	.9963
53	6.91778	2.85326	13.997	4950.	4875.	.9848	244.191	242.905	.9947
54	7.63905	3.04652	11.678	4951.	4868.	.9833	244.229	242.566	.9932
55	8.07105	3.16228	10.619	4947.	4860.	.9824	244.042	242.166	.9923
55	8.07105	3.16228	10.619	4947.	4860.	.9824	244.042	242.166	.9923
56	9.11219	3.44125	8.561	4926.	4830.	.9805	243.006	240.681	.9904
57	9.86845	3.64389	7.456	4901.	4800.	.9793	241.782	239.175	.9892
58	10.42317	3.79253	6.961	4878.	4774.	.9786	240.651	237.878	.9885
59	11.00332	3.94798	6.460	4850.	4744.	.9780	239.270	236.373	.9879
60	11.48960	4.07828	7.173	4824.	4718.	.9780	237.964	235.084	.9879
61	13.29062	4.56086	5.131	4703.	4605.	.9791	232.018	229.471	.9890
62	14.20128	4.80487	4.435	4630.	4534.	.9793	228.390	225.922	.9892
63	15.24122	5.08352	3.777	4536.	4442.	.9793	223.767	221.350	.9892

I	X	Y	P	F(1-D)	F(2-D)	ETA(F)	ISP(1-D)	ISP(2-D)	ETA(I)
64	16.27753	5.36120	3.255	4433.	4340.	.9791	218.674	216.271	.9890
65	17.35752	5.65058	2.815	4315.	4224.	.9788	212.867	210.451	.9886
66	18.51457	5.96061	2.431	4178.	4087.	.9782	206.100	203.645	.9881
67	19.81259	6.38841	2.083	4011.	3920.	.9774	197.857	195.333	.9872
68	21.38376	6.72941	1.769	3790.	3700.	.9761	186.982	184.347	.9859
69	23.49345	7.29470	1.409	3464.	3373.	.9737	170.879	168.061	.9835
70	26.67524	8.14726	1.050	2908.	2815.	.9682	143.440	140.287	.9780
71	28.51233	8.63950	.906	2552.	2459.	.9635	125.913	122.540	.9732

PERFORMANCE OF THE SCARFED EXTENSION

I	X	Y	P	PSI	DFX	ISPX	DFY	ISPY	ISP
55	8.871	3.162	10.619	0.000	0.	242.166	0.	0.000	242.166
56	9.112	3.442	8.361	41.905	.2611E+02	240.465	.1255E+02	.625	240.461
57	9.868	3.644	7.456	54.535	.2218E+02	239.764	.2668E+02	1.955	239.375
58	10.423	3.772	6.961	61.592	.1763E+02	238.886	.2618E+02	3.259	237.478
59	11.083	3.948	6.460	68.150	.1931E+02	237.924	.3247E+02	4.877	236.373
60	11.083	3.948	6.460	68.150	0.	237.924	0.	4.877	236.373
61	11.083	3.948	6.460	68.150	0.	237.924	0.	4.877	236.373
62	11.083	3.948	6.460	68.150	0.	237.924	0.	4.877	236.373
63	11.490	4.078	7.173	73.856	.1573E+02	237.140	.2901E+02	6.323	235.884
64	11.490	4.078	7.173	73.856	0.	237.140	0.	6.323	235.884
65	13.201	4.561	5.131	88.131	.6188E+02	234.060	.1312E+03	12.858	229.471
66	14.281	4.885	4.435	96.508	.3586E+02	232.313	.8452E+02	17.869	225.922
67	15.241	5.084	3.777	101.685	.4187E+02	230.227	.1079E+03	22.446	221.358
68	16.278	5.361	3.255	107.042	.4296E+02	228.806	.1174E+03	28.294	216.271
69	17.374	5.651	2.815	112.965	.4540E+02	225.824	.1393E+03	34.787	210.451
70	18.515	5.961	2.431	118.753	.4868E+02	223.399	.1460E+03	42.862	203.645
71	19.813	6.338	2.083	124.982	.5385E+02	220.715	.1682E+03	50.448	195.333
72	21.384	6.779	1.789	132.241	.6291E+02	217.580	.2046E+03	60.637	184.347
73	23.443	7.285	1.409	141.918	.7790E+02	213.699	.2643E+03	73.806	168.861
74	26.675	8.197	1.058	158.471	.9223E+02	209.103	.3289E+03	90.194	148.287
75	28.912	8.640	.904	180.000	.9130E+02	208.042	.7981E+02	94.131	122.548

SUMMARY OF OVERALL SCARFED NOZZLE PERFORMANCE PARAMETERS

```
MDOT   =   .[illegible]E+02 LBM/SEC

FSN    =   -.[illegible]E+04 LBF      ISPSN   =  2[illegible].042 (LBF-SEC)/LBM

FYN    =   .[illegible]E+0[illegible] LBF      ISPYN   =  [illegible].231 (LBF-SEC)/LBM
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SUMMARY OF OVERALL MISSILE PERFORMANCE PARAMETERS

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FXM    =   -.[illegible]E+04 LBF      ISPXM   =  22[illegible] (LBF-SEC)/LBM

FYM    =   -.[illegible]E+03 LBF      ISPYM   =  22.[illegible] (LBF-SEC)/LBM

ETA    =   [illegible].[illegible]527                   BETAEFF =  1.053 DEG
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APPENDIX G.

OUTPUT FOR SAMPLE CASE NO. 11

IRROTATIONAL FLOWFIELD ALONG RIGHT-RUNNING CHARACTERISTICS EMANATING FROM THE SUPERSONIC TURNING CONTOUR.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
27	2	.153	1.041	5004.	1341.	1.649	5180.	15.000	236.064	.13305	3931.	1000.	5000.	20.069	3889.
27	36	3.609	0.000	7979.	0.	3.209	7979.	0.000	14.294	.01286	2463.	1000.	5000.	-.017	-3.
28	3	.292	1.078	5023.	1346.	1.658	5201.	15.000	233.036	.13162	3922.	1000.	5000.	20.069	3944.
28	36	3.609	0.000	7979.	0.	3.209	7979.	0.000	14.294	.01286	2463.	1000.	5000.	-.017	-3.
29	4	.422	1.113	5064.	1357.	1.675	5243.	15.000	226.856	.12871	3905.	1000.	5000.	20.069	3996.
29	36	3.609	0.000	7979.	0.	3.209	7979.	0.000	14.294	.01286	2463.	1000.	5000.	-.017	-3.
30	5	.545	1.146	5119.	1372.	1.698	5300.	15.000	218.612	.12480	3881.	1000.	5000.	20.069	4044.
30	36	3.609	0.000	7979.	0.	3.209	7979.	0.000	14.294	.01286	2463.	1000.	5000.	-.017	-3.
31	6	.664	1.178	5184.	1389.	1.726	5367.	15.000	209.133	.12027	3852.	1000.	5000.	20.069	4091.
31	36	3.609	0.000	7979.	0.	3.209	7979.	0.000	14.294	.01286	2463.	1000.	5000.	-.017	-3.
32	7	.790	1.209	5255.	1408.	1.757	5441.	15.000	199.031	.11541	3821.	1000.	5000.	20.069	4135.
32	37	3.635	0.000	6194.	0.	2.099	6194.	0.000	111.957	.07145	3471.	1000.	5000.	.097	23.
33	8	.892	1.239	5330.	1428.	1.790	5518.	15.000	188.735	.11642	3787.	1000.	5000.	20.069	4176.
33	38	4.008	0.000	7867.	0.	3.119	7867.	0.000	16.947	.01482	2534.	1000.	5000.	.105	25.
34	9	1.001	1.268	5405.	1448.	1.824	5596.	15.000	178.617	.10546	3752.	1000.	5000.	20.069	4215.
34	39	4.359	0.000	5544.	0.	1.801	5544.	0.000	185.305	.10874	3775.	1000.	5000.	.186	42.
35	10	1.108	1.297	5481.	1469.	1.858	5674.	15.000	168.823	.10062	3717.	1000.	5000.	20.069	4252.
35	40	4.376	0.000	7128.	0.	2.608	7128.	0.000	44.423	.03307	2976.	1000.	5000.	.177	40.
36	11	1.212	1.324	5553.	1488.	1.892	5751.	15.000	159.490	.09596	3682.	1000.	5000.	20.069	4286.
36	41	4.647	0.000	6884.	0.	2.464	6884.	0.000	58.072	.04135	3111.	1000.	5000.	.172	39.
37	12	1.312	1.351	5627.	1508.	1.925	5825.	15.000	150.793	.09158	3648.	1000.	5000.	20.069	4318.
37	42	4.938	0.000	7188.	0.	2.646	7188.	0.000	41.417	.03120	2941.	1000.	5000.	.165	38.
38	13	1.412	1.378	5698.	1527.	1.959	5899.	15.000	142.464	.08734	3613.	1000.	5000.	20.069	4348.
38	43	5.222	0.000	7271.	0.	2.699	7271.	0.000	37.533	.02874	2893.	1000.	5000.	.162	37.
39	14	1.511	1.405	5768.	1545.	1.992	5971.	15.000	134.581	.08330	3579.	1000.	5000.	20.069	4377.
39	44	5.509	0.000	7369.	0.	2.762	7369.	0.000	33.301	.02601	2836.	1000.	5000.	.160	37.
40	15	1.611	1.431	5837.	1564.	2.026	6042.	15.000	127.047	.07939	3545.	1000.	5000.	20.069	4404.
40	45	5.805	0.000	7458.	0.	2.822	7458.	0.000	29.779	.02370	2784.	1000.	5000.	.159	36.
41	16	1.714	1.459	5906.	1583.	2.060	6115.	15.000	119.707	.07555	3510.	1000.	5000.	20.069	4432.
41	46	6.040	0.000	7405.	0.	2.786	7405.	0.000	31.841	.02506	2815.	1000.	5000.	.280	63.
42	17	1.825	1.489	5980.	1602.	2.097	6191.	15.000	112.289	.07163	3473.	1000.	5000.	20.069	4460.
42	47	6.400	0.000	7601.	0.	2.921	7601.	0.000	24.665	.02026	2698.	1000.	5000.	.277	62.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
43	18	1.954	1.525	6062.	1624.	2.159	6276.	15.000	104.325	.06737	3431.	1000.	5000.	20.069	4490.
43	48	6.914	0.000	7694.	0.	2.988	7694.	0.000	21.735	.01623	2641.	1000.	5000.	.275	62.
44	19	2.117	1.567	6163.	1651.	2.191	6380.	15.000	95.102	.06237	3378.	1000.	5000.	20.063	4526.
44	49	7.351	0.000	7816.	0.	3.061	7816.	0.000	18.246	.01576	2565.	1000.	5000.	.273	61.
45	20	2.346	1.625	6296.	1687.	2.263	6518.	15.000	83.710	.05608	3307.	1090.	5000.	20.069	4572.
45	50	8.130	0.000	7968.	0.	3.200	7968.	0.000	14.541	.01304	2470.	1000.	5000.	.269	61.
46	21	2.700	1.723	6486.	1738.	2.368	6715.	15.000	69.143	.04782	3203.	1000.	5000.	20.069	4634.
46	51	9.392	0.000	8174.	0.	3.375	8174.	0.000	10.438	.00989	2337.	1000.	5000.	.263	59.
47	22	3.267	1.875	6752.	1809.	2.525	6990.	15.000	51.830	.03761	3053.	1000.	5000.	20.069	4712.
47	52	11.548	0.000	8449.	0.	3.633	8449.	0.000	6.416	.00659	2155.	1000.	5000.	.251	56.
48	23	3.814	2.022	6960.	1867.	2.661	7212.	15.000	40.275	.03048	2927.	1000.	5000.	20.069	4767.
48	53	13.721	0.000	8651.	0.	3.845	8651.	0.000	4.318	.00474	2018.	1000.	5000.	.244	54.
49	24	4.377	2.173	7155.	1917.	2.756	7405.	15.000	31.829	.02505	2815.	1000.	5000.	20.069	4810.
49	54	16.038	0.000	8821.	0.	4.040	8821.	0.000	3.007	.00351	1900.	1000.	5000.	.238	52.
50	25	4.964	2.330	7318.	1961.	2.904	7576.	15.000	25.502	.02083	2713.	1000.	5000.	20.069	4840.
50	55	18.506	0.000	8963.	0.	4.217	8963.	0.000	2.167	.00267	1799.	1000.	5000.	.233	51.
51	26	5.582	2.495	7466.	2001.	3.015	7730.	15.000	20.663	.01746	2619.	1000.	5000.	20.069	4861.
51	56	21.141	0.000	9085.	0.	4.384	9085.	0.000	1.606	.00208	1711.	1000.	5000.	.229	50.
52	27	6.235	2.670	7601.	2037.	3.121	7869.	15.000	16.893	.01478	2533.	1000.	5000.	20.069	4873.
52	57	23.965	0.000	9192.	0.	4.541	9192.	0.000	1.213	.00165	1633.	1000.	5000.	.225	49.
53	28	6.918	2.853	7720.	2069.	3.220	7992.	15.000	13.997	.01263	2455.	1000.	5000.	20.069	4875.
53	58	26.872	0.000	9280.	0.	4.678	9280.	0.000	.952	.00135	1568.	1000.	5000.	.221	48.
54	29	7.639	3.047	7830.	2098.	3.316	8106.	15.000	11.678	.01086	2382.	1000.	5000.	20.069	4868.
54	59	29.983	0.000	9362.	0.	4.814	9362.	0.000	.751	.00110	1507.	1000.	5000.	.217	47.
55	30	8.359	3.239	7922.	2123.	3.399	8201.	15.000	9.975	.00953	2320.	1000.	5000.	20.069	4853.
55	60	32.880	0.000	9417.	0.	4.908	9417.	0.000	.637	.00096	1467.	1000.	5000.	.214	46.
56	31	9.112	3.441	8008.	2146.	3.480	8290.	15.000	8.562	.00839	2262.	1000.	5000.	20.069	4830.
56	61	35.979	0.000	9476.	0.	5.017	9476.	0.000	.528	.00082	1422.	1000.	5000.	.211	45.
57	32	9.763	3.616	8065.	2161.	3.536	8349.	15.000	7.765	.00766	2222.	1000.	5000.	20.069	4805.
57	62	37.050	0.000	9482.	0.	5.027	9482.	0.000	.519	.00381	1418.	1000.	5000.	.241	52.
58	33	10.431	3.795	8120.	2176.	3.591	8406.	15.000	6.947	.00705	2184.	1000.	5000.	20.069	4774.
58	65	40.314	0.000	9515.	0.	5.091	9515.	0.000	.466	.00074	1392.	1000.	5000.	.238	51.
59	34	10.706	3.868	8117.	2175.	3.588	8404.	15.000	6.983	.00708	2186.	1000.	5000.	20.069	4760.
59	65	40.314	0.000	9515.	0.	5.091	9515.	0.000	.466	.00074	1392.	1000.	5000.	.238	51.
60	35	10.964	3.937	8115.	2174.	3.586	8401.	15.000	7.011	.00710	2187.	1000.	5000.	20.069	4747.
60	65	40.314	0.000	9515.	0.	5.091	9515.	0.000	.466	.00074	1392.	1000.	5000.	.238	51.

I	J	K	T	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	HDOT	F
61	36	12.451	4.336	8272.	2217.	3.751	8564.	15.000	5.143	.00548	2077.	1000.	5000.	20.069	4657.
61	64	48.260	0.000	9629.	0.	5.321	9629.	0.000	.316	.00054	1305.	1000.	5000.	.267	68.
62	41	12.764	4.428	8215.	2201.	3.689	8505.	15.000	5.770	.00604	2118.	1000.	5000.	20.069	4636.
62	64	48.260	0.000	9629.	-0.	5.321	9629.	0.000	.316	.00054	1305.	1000.	5000.	.267	68.
63	42	13.168	4.794	8339.	2235.	3.825	8634.	15.000	4.476	.00489	2030.	1000.	5000.	20.069	4532.
63	65	51.102	0.000	9548.	0.	5.154	9548.	0.000	.418	.00068	1367.	1000.	5000.	.361	87.
64	43	15.184	5.040	8446.	2252.	3.902	8703.	15.000	3.879	.00434	1982.	1000.	5000.	20.069	4450.
64	66	56.838	0.000	9723.	0.	5.528	9723.	0.000	.225	.00040	1233.	1000.	5000.	.352	84.
65	44	16.113	5.317	8471.	2270.	3.980	8770.	15.000	3.359	.00385	1935.	1000.	5000.	20.069	4352.
65	67	62.561	0.000	9779.	0.	5.659	9779.	0.000	.181	.00034	1190.	1000.	5000.	.348	83.
66	45	17.077	5.576	8527.	2285.	4.049	8828.	15.000	2.958	.00346	1894.	1000.	5000.	20.069	4250.
66	68	67.967	0.000	9832.	0.	5.794	9832.	0.000	.146	.00028	1148.	1000.	5000.	.344	82.
67	46	17.732	5.751	8562.	2294.	4.092	8864.	15.000	2.732	.00324	1869.	1000.	5000.	20.069	4176.
67	69	71.422	0.000	9859.	0.	5.863	9859.	0.000	.131	.00026	1127.	1000.	5000.	.342	82.
68	47	19.436	6.208	8654.	2319.	4.214	8960.	15.000	2.186	.00269	1801.	1000.	5000.	20.069	3966.
68	70	82.839	0.000	9963.	0.	6.152	9963.	0.000	.083	.00018	1045.	1000.	5000.	.334	79.
69	48	23.013	6.630	8726.	2338.	4.313	9033.	15.000	1.828	.00232	1748.	1000.	5000.	20.069	3750.
69	71	92.671	0.000	10016.	0.	6.315	10016.	0.000	.065	.00014	1002.	1000.	5000.	.329	78.
70	49	23.178	7.210	8812.	2361.	4.459	9125.	15.000	1.456	.00192	1685.	1000.	5000.	20.069	3420.
70	72	106.455	0.000	10090.	0.	6.558	10090.	0.000	.045	.00011	943.	1000.	5000.	.321	76.
71	50	26.359	8.065	8921.	2391.	4.608	9236.	15.000	1.077	.00149	1601.	1000.	5000.	20.069	2871.
71	73	129.397	0.000	10180.	0.	6.887	10180.	0.000	.028	.00007	871.	1000.	5000.	.311	73.
72	51	28.512	8.660	8982.	2407.	4.708	9299.	15.000	.903	.00129	1554.	1000.	5000.	20.069	2456.

PROPERTIES ALONG THE NOZZLE WALL CONTOUR.

I	X	Y	P	F(1-D)	F(2-D)	ETA(F)	ISP(1-D)	ISP(2-D)	ETA(I)
11	0.00000	1.00000	444.242	3855.	3832.	.9940	190.176	190.942	1.0040
12	.00017	1.00000	424.910	3809.	3832.	1.0060	187.898	190.942	1.0162
13	.00035	1.00001	436.852	3809.	3832.	1.0060	187.899	190.943	1.0162
14	.00052	1.00001	399.830	3809.	3832.	1.0060	187.900	190.943	1.0162
15	.00070	1.00002	373.685	3809.	3832.	1.0060	187.902	190.945	1.0162
16	.00087	1.00004	358.305	3809.	3832.	1.0060	187.904	190.946	1.0162
17	.00105	1.00005	343.606	3809.	3832.	1.0060	187.907	190.948	1.0162
18	.00122	1.00007	329.525	3809.	3832.	1.0060	187.911	190.950	1.0162
19	.00139	1.00010	316.011	3809.	3832.	1.0060	187.914	190.952	1.0162
20	.00156	1.00012	303.024	3809.	3832.	1.0060	187.919	190.955	1.0162
21	.00174	1.00015	290.529	3810.	3832.	1.0060	187.923	190.957	1.0161
22	.00191	1.00018	278.499	3810.	3832.	1.0060	187.929	190.960	1.0161
23	.00208	1.00022	266.909	3810.	3832.	1.0060	187.934	190.963	1.0161
24	.00225	1.00026	255.739	3810.	3832.	1.0059	187.940	190.965	1.0161
25	.00242	1.00030	244.949	3810.	3833.	1.0059	187.947	190.968	1.0161
26	.00259	1.00034	234.563	3810.	3833.	1.0057	187.958	190.972	1.0161
27	.15756	1.04053	236.064	3919.	3889.	.9925	193.310	193.804	1.0026
28	.29176	1.07792	233.036	4001.	3946.	.9858	197.365	196.523	.9957
29	.42135	1.11266	226.856	4068.	3998.	.9821	200.688	199.093	.9921
30	.54538	1.14578	218.612	4126.	4044.	.9802	203.534	201.529	.9901
31	.66437	1.17766	209.133	4177.	4091.	.9794	206.040	203.838	.9893
32	.77914	1.20858	199.051	4222.	4135.	.9793	208.284	206.024	.9892
33	.89202	1.23866	188.758	4263.	4176.	.9795	210.315	208.089	.9894
34	1.00145	1.26797	178.617	4301.	4215.	.9800	212.166	210.031	.9899
35	1.10799	1.29653	168.823	4335.	4252.	.9807	213.861	211.854	.9906
36	1.21198	1.32439	159.490	4367.	4286.	.9815	215.421	213.562	.9914
37	1.31227	1.35127	150.773	4396.	4318.	.9822	216.846	215.142	.9921
38	1.41220	1.37805	142.464	4423.	4349.	.9830	218.194	216.651	.9929
39	1.51136	1.40461	134.581	4449.	4377.	.9838	219.465	218.084	.9937
40	1.61123	1.43157	127.047	4474.	4404.	.9845	220.684	219.463	.9945
41	1.71927	1.45899	119.707	4498.	4432.	.9853	221.882	220.820	.9952
42	1.82531	1.48874	112.289	4523.	4460.	.9860	223.109	222.211	.9960
43	1.95376	1.52516	104.525	4550.	4490.	.9868	224.452	223.729	.9968
44	2.11710	1.56697	95.102	4582.	4526.	.9877	226.049	225.527	.9977
45	2.34641	1.62687	83.710	4624.	4572.	.9888	228.105	227.820	.9988
46	2.70542	1.72322	69.143	4681.	4634.	.9899	230.901	230.882	.9999
47	3.26681	1.87499	51.830	4755.	4712.	.9908	234.582	234.765	1.0008
48	3.81419	2.02156	40.275	4812.	4767.	.9907	237.386	237.551	1.0007
49	4.37757	2.17254	31.829	4858.	4810.	.9900	239.642	239.651	1.0000
50	4.96412	2.32978	25.502	4894.	4840.	.9890	241.429	241.187	.9990
51	5.58177	2.49528	20.643	4922.	4861.	.9877	242.782	242.225	.9977
52	6.23499	2.67031	16.893	4948.	4873.	.9863	243.707	242.794	.9963
53	6.91778	2.85326	13.997	4950.	4875.	.9848	244.191	242.905	.9947
54	7.63905	3.04652	11.678	4951.	4868.	.9833	244.229	242.566	.9932
55	8.35878	3.23938	9.975	4943.	4853.	.9818	243.835	241.827	.9918
55	9.11207	3.44182	8.562	4926.	4830.	.9805	243.006	240.677	.9904
56	9.76307	3.61546	7.705	4905.	4805.	.9795	241.975	239.410	.9894
57	10.43299	3.79462	6.847	4878.	4774.	.9787	240.634	237.878	.9885
58	10.70589	3.86828	6.983	4865.	4760.	.9784	240.003	237.195	.9883
59	11.96587	3.93741	7.011	4852.	4747.	.9783	239.370	236.545	.9882
60	12.43121	4.33594	5.143	4764.	4657.	.9777	234.999	232.073	.9875
61	12.76379	4.41969	5.779	4742.	4636.	.9777	233.931	231.013	.9875
62	14.16087	4.79393	4.676	4633.	4532.	.9782	228.561	225.831	.9881
63	15.10892	5.04607	3.879	4549.	4450.	.9782	224.383	221.710	.9881

I	X	Y	P	F(1-D)	F(2-D)	ETA(F)	ISP(1-D)	ISP(2-D)	ETA(I)
64	16.11313	5.31715	3.309	4458.	4352.	.9781	219.515	216.871	.9880
65	16.87784	5.57553	2.958	4347.	4250.	.9778	214.421	211.786	.9877
66	17.73226	5.75099	2.732	4272.	4176.	.9776	210.737	208.099	.9875
67	19.33637	6.20761	2.186	4061.	3966.	.9767	200.316	197.630	.9866
68	21.01325	6.63013	1.828	3804.	3750.	.9755	189.633	186.850	.9853
69	23.17891	7.21028	1.455	3515.	3420.	.9731	173.391	170.432	.9829
70	26.35933	8.06261	1.077	2966.	2871.	.9678	146.331	143.045	.9775
71	28.51233	8.63958	.903	2552.	2456.	.9621	125.913	122.367	.9718

APPENDIX H

OUTPUT FOR SAMPLE CASE NO. 13

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NOZZLE PERFORMANCE PREDICTION PROGRAM.

THIS PROGRAM WILL ANALYZE THE FLOWFIELD AND PERFORMANCE OF PROPULSIVE NOZZLES FOR SEVERAL OPTIONS.

   MODE 1. IRROTATIONAL FLOW ALONG RIGHT-RUNNING CHARACTERISTICS.

   MODE 2. IRROTATIONAL FLOW ALONG LEFT-RUNNING CHARACTERISTICS.

   MODE 3. FLOW WITH AN EMBEDDED RIGHT-RUNNING OBLIQUE SHOCK WAVE.

   MODE 4. FLOW IN A SCARFED NOZZLE EXTENSION.

THE PROGRAM WILL ANALYZE THE PERFORMANCE OF A COMPRESSED PROPULSIVE NOZZLE. ICMP = 1.

THE PROGRAM CAN DETECT AND TRACK AN EMBEDDED RIGHT-RUNNING OBLIQUE SHOCK WAVE (MODE = 3 OR 5).  THE FLOWFIELD AHEAD OF
THE SHOCK WAVE IS ASSUMED TO BE IRROTATIONAL, AND THE FLOWFIELD DOWNSTREAM OF THE SHOCK WAVE IS ASSUMED TO BE ROTATIONAL.

THIS PROGRAM WAS WRITTEN BY JOE D. HOFFMAN, SCHOOL OF MECHANICAL ENGINEERING, PURDUE UNIVERSITY, WEST LAFAYETTE IN 47907.
TELEPHONE NUMBER 317-494-1506.

JOB TITLE -

   SAMPLE CASE NO. 15.  QUADRATIC WALL, AA=25.0, XF=6.07104661 EPS=10.0

PROBLEM SPECIFICATIONS -

   ANALYSIS OF A SCARFED NOZZLE WITH AN ATTACHED RIGHT-RUNNING OBLIQUE SHOCK WAVE.

   THE ANALYSIS IS PERFORMED IN EE UNITS (LBF, LBM, IN., FT/SEC, R).

   THERE ARE 11 POINTS ALONG THE INITIAL-VALUE LINE, AND 25 POINTS ALONG THE CIRCULAR ARC THROAT CONTOUR.

   THE OUTPUT FLAGS ARE IWRITE =    0, JWRITE =    0, AND KWRITE = 1.

   THE GRID SPACING CONTROL PARAMETERS ARE DYRATIO = 1.000 AND DARATIO = 1.000.

   THE ACCURACY CONTROL PARAMETERS ARE ICORI =  2, E1 =  0.        , AND E2 =  0.

THERMODYNAMIC MODEL -

   G = 1.200,  RG = 45.000 (FT-LBF)/(LBM-R),  PS =  1000. LBF/IN.**2,  TS =  5000. R,  AND  PA =  15. LBF/IN.**2.
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NOZZLE GEOMETRIC SPECIFICATIONS -

   THE NOZZLE CROSS-SECTION IS AXISYMMETRIC.

   THE NOZZLE THROAT GEOMETRY IS SPECIFIED BY YT =  1.000 IN.,  RTU =  1.000 IN., AND RTD =   .010 IN.

   THE NOZZLE CONTOUR IS QUADRATIC, AA =  25.000 DEG, AE =   3.979 DEG, YE =    3.162 IN., AND EPS =  10.000

   THE NOZZLE LENGTH XE =    8.971 IN. AND THE EXIT RADIUS YE =    3.162 IN.

   THE CHARACTERISTIC GRID IS STOPPED AT XMAX = 1000.000 IN.
GEOMETRIC SPECIFICATION OF THE SCARFED EXTENSION.

   XE =    8.971 IN. AND YE =    3.162 IN.

   XF =   19.025 IN., YF =    3.162 IN., AND AF =  0.000 DEG.

   THE SCARF ANGLE BETA = 30.000 DEG.

$DATA

IUNITS  = 1.

MODE    = 4.

IWALL   = 2.

JWALL   = 0.

NI      = 11.

NT      = 25.

IVS     = 1.

IOUT    = 1.

IWRITE  = 0.

JWRITE  = 0.

KWRITE  = 1.

LWRITE  = 0.

MWRITE  = 0.

NWRITE  = 0.

G       = .12E+01.

RG      = .65E+02.

PS      = .1E+04.

TS      = .5E+04.

PA      = .14696E+02.

DELTA   = .1E+01.

YT      = .1E+01.
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RTU     = .1E+01,
RTO     = .1E-01,
AA      = .25E+02,
AC      = .39786135267613E+01,
EPS     = .1E+02,
VT      = .31622776601684E+01,
XE      = .8071844662E-01,
XMAX    = .1E+04,
AF      = 0.0,
XF      = .19025497760183E+02,
BETA    = .3E+02,
DVRATIO = .1E+01,
DARATIO = .1E+01,
ICORI   = 2,
ICORR   = 3,
Z1      = 0.0,
Z2      = 0.0,
IDUMP   = 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
ICMP    = 0,
IPLOT   = 0,
ICPLOT  = 0,
VMAX    = .25E+02,
XDES    = 0.0,
YDES    = 0.0,
IE      = 0,
JE      = 0,
$END
```

INITIAL-VALUE LINE SPECIFICATIONS.

INITIAL-VALUE LINE CALCULATED BY THE KLIEGEL-LEVINE METHOD.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
1	11	.262	0.000	3471.	0.	1.031	3471.	0.00	545.67	.26746	4520.	1000.	5000.	0.000	0.
2	10	.260	.100	3475.	7.	1.032	3475.	.11	545.00	.26719	4519.	1000.	5000.	.203	39.
3	9	.252	.200	3485.	13.	1.035	3485.	.21	542.99	.26636	4516.	1000.	5000.	.810	154.
4	8	.239	.300	3502.	19.	1.041	3502.	.30	539.56	.26496	4511.	1000.	5000.	1.823	347.
5	7	.220	.400	3527.	23.	1.049	3527.	.37	534.58	.26292	4504.	1000.	5000.	3.241	617.
6	6	.197	.500	3560.	25.	1.060	3561.	.41	527.79	.26013	4495.	1000.	5000.	5.063	963.
7	5	.168	.600	3605.	25.	1.075	3606.	.40	518.81	.25644	4482.	1000.	5000.	7.288	1387.
8	4	.134	.700	3665.	22.	1.095	3665.	.35	507.02	.25157	4465.	1000.	5000.	9.912	1887.
9	3	.094	.800	3743.	17.	1.121	3743.	.26	491.54	.24516	4442.	1000.	5000.	12.928	2462.
10	2	.050	.900	3846.	9.	1.156	3846.	.13	471.15	.23665	4411.	1000.	5000.	16.321	3112.
11	1	0.000	1.000	3984.	-0.	1.203	3984.	-.00	444.24	.22534	4368.	1000.	5000.	20.069	3832.

INITIAL-VALUE LINE PERFORMANCE PARAMETERS.

MDOT = 20.069 LBM/SEC.   MDOT(1-D) = 20.272 LBM/SEC.   CD = .9900

F = 3832. LBF.   F(1-D) = 3855. LBF.   ETAF = .9940

ISP = 190.942 LBF-SEC/LBM.   ISP(1-D) = 190.176 LBF-SEC/LBM.   ETAI = 1.0040

IRROTATIONAL FLOWFIELD ALONG RIGHT-RUNNING CHARACTERISTICS EMANATING FROM THE INITIAL-VALUE LINE.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
1	11	.262	0.000	3471.	0.	1.031	3471.	0.000	545.669	.26746	4520.	1000.	5000.	0.000	0.
2	10	.260	.100	3475.	7.	1.032	3475.	.118	545.005	.26719	4519.	1000.	5000.	.263	39.
2	12	.288	0.000	3525.	0.	1.048	3525.	0.000	534.839	.26303	4505.	1000.	5000.	-.000	-0.
3	9	.252	.200	3485.	13.	1.035	3485.	.214	542.993	.26636	4516.	1000.	5000.	.818	154.
3	13	.316	0.000	3589.	0.	1.070	3589.	0.000	522.075	.25778	4487.	1000.	5000.	-.000	-0.
4	8	.239	.300	3502.	19.	1.041	3502.	.303	539.563	.26496	4511.	1000.	5000.	1.623	347.
4	14	.344	0.000	3656.	0.	1.092	3656.	0.000	508.677	.25226	4467.	1000.	5000.	-.000	-0.
5	7	.220	.400	3527.	23.	1.049	3527.	.371	534.577	.26292	4504.	1000.	5000.	3.241	617.
5	15	.374	0.000	3726.	0.	1.116	3726.	0.000	494.749	.24649	4447.	1000.	5000.	-.000	-0.
6	6	.197	.500	3568.	25.	1.060	3561.	.406	527.790	.26013	4495.	1000.	5000.	5.063	963.
6	16	.405	0.000	3800.	0.	1.146	3800.	0.000	480.224	.24044	4425.	1000.	5000.	-.000	-0.
7	5	.168	.600	3605.	25.	1.075	3606.	.402	518.887	.25644	4462.	1000.	5000.	7.268	1387.
7	17	.438	0.000	3879.	0.	1.167	3879.	0.000	464.615	.23391	4400.	1000.	5000.	-.000	-0.
8	4	.134	.700	3665.	22.	1.095	3665.	.351	507.329	.25157	4465.	1000.	5000.	9.912	1887.
8	18	.478	0.000	3971.	0.	1.199	3971.	0.000	446.819	.22642	4372.	1000.	5000.	-.001	-0.
9	3	.094	.800	[illegible]	17.	1.121	3743.	.256	491.543	.24516	4442.	1000.	5000.	12.928	2462.
9	19	.528	0.000	[illegible]	0.	1.238	4384.	0.000	424.917	.21714	4335.	1000.	5000.	-.001	-0.
10	2	.05[illegible]	.900	3846.	9.	1.156	3846.	.128	471.151	.23665	4411.	1000.	5000.	16.321	3112.
10	20	.595	0.000	4236.	0.	1.292	4236.	0.000	396.090	.20479	4285.	1000.	5000.	-.002	-0.
11	1	[illegible]	1.000	3984.	-0.	1.203	[illegible]	-.000	444.242	.22534	4368.	1000.	5000.	20.869	3832.
11	21	.72[illegible]	0.000	4450.	0.	1.369	4450.	0.000	356.905	.18776	4211.	1000.	5000.	-.003	-0.

IRROTATIONAL FLOWFIELD ALONG RIGHT-RUNNING CHARACTERISTICS EMANATING FROM THE INITIAL EXPANSION CONTOUR.

I	J	X	Y	U	V	W	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
12	1	.000	1.000	4083.	71.	1.258	4084.	1.000	424.910	.21713	4335.	1000.	5000.	20.069	3832.
12	22	.851	0.000	4842.	0.	1.516	4842.	0.000	289.035	.15750	4066.	1000.	5000.	-.005	-1.
13	1	.000	1.000	4177.	146.	1.272	4179.	2.000	406.852	.20942	4304.	1000.	5000.	20.069	3832.
13	23	.992	0.000	5162.	0.	1.642	5162.	0.000	238.791	.13433	3938.	1000.	5000.	-.006	-1.
14	1	.081	1.000	4264.	223.	1.304	4270.	3.000	389.830	.20209	4273.	1000.	5000.	20.069	3832.
14	24	1.129	0.000	5457.	0.	1.764	5457.	0.000	196.875	.11437	3814.	1000.	5000.	-.007	-1.
15	1	.101	1.000	4347.	304.	1.335	4357.	4.000	373.685	.19509	4243.	1000.	5000.	20.069	3832.
15	25	1.269	0.000	5728.	0.	1.887	5728.	0.000	162.270	.09735	3693.	1000.	5000.	-.008	-1.
16	1	.101	1.000	4425.	387.	1.366	4442.	5.000	358.305	.18837	4214.	1000.	5000.	20.069	3832.
16	26	1.419	0.000	5982.	0.	1.997	5982.	0.000	133.381	.08268	3574.	1000.	5000.	-.009	-1.
17	1	.101	1.000	4499.	473.	1.396	4524.	6.000	343.606	.18191	4185.	1000.	5000.	20.069	3832.
17	27	1.564	0.000	6223.	0.	2.113	6223.	0.000	109.248	.07001	3457.	1000.	5000.	-.010	-1.
18	1	.101	1.000	4570.	561.	1.426	4604.	7.000	329.525	.17568	4155.	1000.	5000.	20.069	3832.
18	28	1.721	0.000	6451.	0.	2.228	6451.	0.000	89.167	.05908	3342.	1000.	5000.	-.011	-2.
19	1	.101	1.000	4616.	652.	1.455	4662.	8.000	316.011	.16965	4127.	1000.	5000.	20.069	3832.
19	29	1.891	0.000	6669.	0.	2.343	6669.	0.000	72.345	.04965	3227.	1000.	5000.	-.011	-2.
20	1	.102	1.000	4698.	744.	1.484	4750.	9.000	303.024	.16382	4098.	1000.	5000.	20.069	3832.
20	30	2.077	0.000	6879.	0.	2.460	6879.	0.000	58.428	.04156	3115.	1000.	5000.	-.012	-2.
21	1	.102	1.000	4760.	839.	1.512	4833.	10.000	290.529	.15817	4069.	1000.	5000.	20.069	3832.
21	31	2.275	0.000	7079.	0.	2.579	7079.	0.000	46.934	.03462	3003.	1000.	5000.	-.013	-2.
22	1	.102	1.000	4817.	936.	1.541	4907.	11.000	278.499	.15270	4041.	1000.	5000.	20.069	3832.
22	32	2.492	0.000	7272.	0.	2.699	7272.	0.000	37.483	.02871	2893.	1000.	5000.	-.014	-2.
23	1	.102	1.000	4871.	1035.	1.569	4979.	12.000	266.909	.14738	4012.	1000.	5000.	20.069	3832.
23	33	2.713	0.000	7459.	0.	2.822	7459.	0.000	29.752	.02368	2783.	1000.	5000.	-.014	-2.
24	1	.102	1.000	4921.	1136.	1.597	5051.	13.000	255.739	.14222	3984.	1000.	5000.	20.069	3832.
24	34	2.951	0.000	7638.	0.	2.948	7638.	0.000	23.463	.01943	2675.	1000.	5000.	-.015	-2.
25	1	.102	1.000	4969.	1239.	1.625	5121.	14.000	244.969	.13722	3955.	1000.	5000.	20.069	3833.
25	35	3.204	0.000	7811.	0.	3.077	7811.	0.000	18.379	.01585	2569.	1000.	5000.	-.016	-3.
26	1	.083	1.000	5011.	1343.	1.653	5190.	15.000	234.583	.13235	3927.	1000.	5000.	20.069	3833.
26	36	3.469	0.000	7979.	0.	3.209	7979.	0.000	14.294	.01286	2463.	1000.	5000.	-.017	-3.
27	1	.083	1.000	5055.	1449.	1.681	5258.	16.000	224.568	.12762	3898.	1000.	5000.	20.069	3833.
27	37	3.773	0.000	8141.	0.	3.346	8141.	0.000	11.035	.01036	2359.	1000.	5000.	-.018	-3.
28	1	.083	1.000	5093.	1557.	1.709	5326.	17.000	214.908	.12303	3870.	1000.	5000.	20.069	3833.
28	38	4.382	0.000	8297.	0.	3.487	8297.	0.000	8.453	.00830	2257.	1000.	5000.	-.018	-3.
29	1	.083	1.000	5129.	1666.	1.737	5393.	18.000	205.593	.11857	3841.	1000.	5000.	20.069	3833.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
29	39	4.891	0.000	8449.	0.	3.632	8449.	0.000	6.425	.00668	2136.	1000.	5000.	-.019	-3.
30	1	.005	1.001	5161.	1777.	1.765	5458.	19.000	196.618	.11424	3813.	1000.	5000.	20.069	3833.
30	41	5.326	0.000	8595.	0.	3.784	8595.	0.000	4.838	.00552	2056.	1000.	5000.	-.020	-3.
31	1	.003	1.001	5191.	1859.	1.792	5524.	20.000	187.949	.11043	3789.	1000.	5000.	20.069	3833.
31	41	5.978	0.000	8737.	0.	3.941	8737.	0.000	3.612	.00409	1959.	1000.	5000.	-.021	-4.
32	1	.004	1.001	5217.	2003.	1.820	5588.	21.000	179.599	.10594	3756.	1000.	5000.	20.069	3833.
32	42	6.673	0.000	8873.	0.	4.104	8873.	0.000	2.672	.00318	1863.	1000.	5000.	-.022	-4.
33	1	.004	1.001	5240.	2117.	1.848	5652.	22.000	171.552	.10197	3727.	1000.	5000.	20.069	3833.
33	43	7.475	0.000	9006.	0.	4.275	9006.	0.000	1.956	.00245	1768.	1000.	5000.	-.025	-4.
34	1	.004	1.001	5261.	2233.	1.876	5715.	23.000	163.799	.09812	3698.	1000.	5000.	20.069	3833.
34	44	8.398	0.000	9134.	0.	4.453	9134.	0.000	1.418	.00187	1676.	1000.	5000.	-.024	-4.
35	1	.005	1.001	5276.	2358.	1.904	5778.	24.000	156.330	.09437	3670.	1000.	5000.	20.069	3833.
35	45	9.380	0.000	9257.	0.	4.641	9257.	0.000	1.016	.00142	1585.	1000.	5000.	-.025	-4.
36	1	.005	1.001	5293.	2468.	1.932	5840.	25.000	149.137	.09074	3641.	1000.	5000.	20.069	3833.
36	45	10.765	0.000	9376.	0.	4.837	9376.	0.000	.720	.00107	1497.	1000.	5000.	-.027	-5.

IRROTATIONAL FLOWFIELD ALONG LEFT-RUNNING CHARACTERISTICS EMANATING FROM THE KERNEL RIGHT-RUNNING CHARACTERISTIC.

I	J	X	Y	U	V	W	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
36	1	.100	1.081	5553.	2464.	1.833	5840.	27.000	149.137	.09074	3641.	1000.	5000.	20.069	3833.
36	2	.113	.983	5366.	2573.	1.843	5862.	26.029	146.558	.08943	3631.	1000.	5000.	18.778	3613.
37	2	.171	1.078	5223.	2410.	1.919	5854.	24.612	147.453	.08989	3634.	1000.	5000.	20.069	3901.
36	3	.216	.962	5266.	2659.	1.959	5900.	26.792	142.372	.08730	3613.	1000.	5000.	17.592	3412.
38	3	.138	1.109	5372.	2414.	1.955	5889.	24.246	143.523	.08788	3618.	1000.	5000.	20.069	3966.
36	4	.311	.977	5383.	2735.	1.981	5947.	27.326	137.219	.08466	3591.	1000.	5000.	16.525	3233.
39	4	.474	1.215	5429.	2406.	1.977	5938.	23.902	138.149	.08513	3595.	1000.	5000.	20.069	4027.
36	5	.413	.972	5313.	2768.	2.036	6000.	27.685	131.510	.08171	3566.	1000.	5000.	15.561	3071.
40	5	.614	1.376	5496.	2396.	2.004	5996.	23.572	131.917	.08192	3567.	1000.	5000.	20.069	4085.
36	6	.493	.975	5353.	2835.	2.083	6057.	27.907	125.544	.07861	3538.	1000.	5000.	14.686	2924.
41	6	.749	1.333	5566.	2392.	2.044	6060.	23.253	125.268	.07847	3537.	1000.	5000.	20.069	4139.
36	7	.572	.968	5390.	2874.	2.061	6116.	28.024	119.537	.07546	3509.	1000.	5000.	13.890	2790.
42	7	.883	1.392	5667.	2368.	2.066	6137.	22.940	118.521	.07493	3504.	1000.	5000.	20.068	4190.
36	8	.653	.967	5451.	2865.	2.098	6177.	28.058	113.643	.07235	3480.	1000.	5000.	13.165	2667.
43	8	1.004	1.444	5718.	2366.	2.099	6135.	22.653	111.899	.07142	3471.	1000.	5000.	20.068	4238.
36	9	.725	.966	5535.	2931.	2.119	6236.	28.029	107.966	.06932	3450.	1000.	5000.	12.504	2554.
44	9	1.133	1.456	5793.	2380.	2.132	6263.	22.332	105.548	.06803	3437.	1000.	5000.	20.068	4283.
36	10	.797	.966	5561.	2951.	2.148	6295.	27.951	102.571	.06643	3421.	1000.	5000.	11.901	2450.
45	10	1.256	1.546	5967.	2374.	2.165	6329.	22.036	99.555	.06479	3404.	1000.	5000.	20.068	4325.
36	11	.866	.967	5617.	2966.	2.177	6352.	27.816	97.488	.06367	3392.	1000.	5000.	11.351	2355.
46	11	1.376	1.594	5838.	2369.	2.198	6395.	21.745	95.958	.06174	3371.	1000.	5000.	20.067	4364.
36	12	.931	.967	5673.	2978.	2.205	6407.	27.695	92.783	.06110	3364.	1000.	5000.	10.857	2257.
47	12	1.492	1.649	6107.	2367.	2.229	6455.	21.462	88.833	.05892	3340.	1000.	5000.	20.067	4400.
36	13	.994	.968	5720.	2986.	2.253	6461.	27.529	88.301	.05863	3337.	1000.	5000.	10.388	2186.
48	13	1.608	1.665	6375.	2354.	2.261	6515.	21.177	83.999	.05624	3309.	1000.	5000.	20.067	4434.
36	14	1.056	.969	5756.	2993.	2.260	6514.	27.345	84.071	.05628	3309.	1000.	5000.	9.954	2109.
49	14	1.723	1.739	6140.	2344.	2.291	6573.	20.896	79.490	.05371	3279.	1000.	5000.	20.067	4466.
36	15	1.117	.971	5842.	2995.	2.288	6566.	27.144	80.031	.05402	3282.	1000.	5000.	9.543	2035.
50	15	1.839	1.774	6305.	2336.	2.322	6629.	20.609	75.258	.05131	3249.	1000.	5000.	20.067	4496.
36	16	1.179	.972	5901.	2997.	2.316	6618.	26.925	76.093	.05179	3255.	1000.	5000.	9.145	1963.
51	16	1.959	1.819	6270.	2321.	2.353	6686.	20.312	71.148	.04897	3219.	1000.	5000.	20.066	4526.
36	17	1.249	.974	5963.	2995.	2.345	6673.	26.674	72.106	.04952	3226.	1000.	5000.	8.743	1889.
52	17	2.080	1.866	6339.	2306.	2.385	6745.	19.989	67.067	.04662	3187.	1000.	5000.	20.066	4556.
36	18	1.319	.976	6035.	2992.	2.379	6734.	26.374	67.812	.04705	3193.	1000.	5000.	8.311	1810.
53	18	2.240	1.920	6415.	2286.	2.422	6810.	19.614	62.742	.04410	3152.	1000.	5000.	20.066	4588.
36	19	1.411	.978	6121.	2983.	2.421	6809.	25.980	62.811	.04414	3152.	1000.	5000.	7.807	1715.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
54	19	2.431	1.988	6506.	2258.	2.466	6889.	19.134	57.808	.04119	3189.	1000.	5000.	20.066	4625.
36	20	1.536	.982	6240.	2965.	2.478	6909.	25.414	56.580	.04645	3098.	1000.	5000.	7.174	1595.
55	20	2.700	2.079	6631.	2215.	2.525	6990.	18.456	51.823	.03761	3053.	1000.	5000.	20.065	4672.
36	21	1.719	.987	6414.	2926.	2.561	7050.	24.518	48.495	.03558	3019	1000.	5000.	6.345	1433.
56	21	3.114	2.213	6803.	2132.	2.609	7129.	17.398	44.339	.03302	2975.	1000.	5000.	20.069	4732.
36	22	1.990	.993	6667.	2603.	2.684	7248.	23.094	38.601	.02942	2907.	1000.	5000.	5.308	1223.
57	22	3.773	2.409	7040.	1978.	2.725	7313.	15.692	35.701	.02757	2869.	1000.	5000.	20.063	4304.
36	23	2.253	.997	6878.	2155.	2.789	7410.	21.831	31.661	.02494	2812.	1000.	5000.	4.535	1062.
58	23	4.400	2.576	7225.	1807.	2.815	7448.	14.042	30.158	.02395	2790.	1000.	5000.	20.066	4852.
36	24	2.467	1.000	7068.	662.	2.887	7553.	20.638	26.321	.02138	2727.	1000.	5000.	3.911	927.
59	24	5.031	2.724	7380.	1617.	2.889	7555.	12.356	26.248	.02133	2726.	1000.	5000.	20.055	4882.
36	25	2.698	1.000	7241.	2565.	2.980	7682.	19.505	22.091	.01848	2649.	1000.	5000.	3.389	811.
60	25	5.672	2.854	7508.	1408.	2.946	7639.	10.622	23.434	.01941	2675.	1000.	5000.	20.029	4899.
36	26	2.930	.999	7402.	2464.	3.069	7801.	18.415	18.655	.01605	2575.	1000.	5000.	2.941	709.
61	26	6.329	2.966	7614.	1182.	2.997	7705.	8.825	21.388	.01799	2634.	1000.	5000.	19.989	4905.
36	27	3.166	.995	7552.	2361.	3.156	7913.	17.358	15.822	.01399	2505.	1000.	5000.	2.552	619.
62	27	7.007	3.060	7696.	938.	3.033	7753.	6.950	19.984	.01700	2605.	1000.	5000.	19.987	4915.
36	28	3.403	.989	7694.	2254.	3.241	8018.	16.329	13.458	.01223	2439.	1000.	5000.	2.209	538.
63	28	7.701	3.133	7759.	681.	3.060	7789.	5.016	18.987	.01629	2585.	1000.	5000.	19.937	4909.
36	29	3.658	.981	7829.	2145.	3.325	8117.	15.324	11.472	.01070	2375.	1000.	5000.	1.906	465.
63	29	7.889	3.084	7796.	607.	3.083	7819.	4.449	18.168	.01570	2564.	100[illegible]	5000.	10.382	2559.
64	29	8.071	3.162	7783.	541.	3.069	7801.	3.979	[illegible]	.01605	2575.	10[illegible]	5000.	10.382	2559.

ROTATIONAL FLOWFIELD ALONG LEFT-RUNNING CHARACTERISTICS THAT PASS THROUGH THE OBLIQUE SHOCK WAVE.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	HDOT	F
64	29	8.071	3.162	7783.	541.	3.059	7801.	3.979	18.649	.01605	2575.	1000.	5000.	10.382	2559.
64	29	8.071	3.162	7611.	0.	2.928	7611.	.000	24.301	.02000	2692.	998.	5000.	10.382	2559.
36	30	3.917	.970	7956.	2034.	3.409	8212.	14.338	9.792	.00938	2313.	1000.	5000.	1.637	399.
64	30	8.573	2.997	7881.	342.	3.136	7888.	2.487	16.414	.01443	2521.	1000.	5000.	18.742	4616.
64	30	8.573	2.997	7691.	-215.	2.989	7694.	-1.602	21.656	.01817	2641.	997.	5000.	18.742	4616.
65	30	9.065	3.162	7768.	0.	3.044	7768.	0.000	19.510	.01666	2595.	998.	4993.	19.190	4721.
36	31	4.187	.956	8078.	1920.	3.492	8303.	13.369	8.364	.00823	2253.	1000.	5000.	1.397	340.
64	31	8.914	2.879	7940.	210.	3.190	7943.	1.513	15.110	.01347	2486.	1000.	5000.	19.210	4730.
64	31	8.914	2.879	7738.	-359.	3.028	7747.	-2.654	20.109	.01708	2609.	997.	5000.	19.210	4730.
66	31	9.803	3.162	7865.	0.	3.119	7865.	0.000	16.934	.01480	2534.	998.	4999.	24.314	5983.
36	32	4.470	.938	8195.	1804.	3.576	8391.	12.415	7.148	.00722	2194.	1000.	5000.	1.183	286.
64	32	9.258	2.754	7994.	78.	3.222	7995.	.562	13.948	.01260	2453.	1000.	5000.	17.201	4233.
64	32	9.258	2.754	7780.	-502.	3.065	7796.	-3.692	18.734	.01610	2578.	997.	5000.	17.201	4233.
67	32	10.600	3.162	7955.	0.	3.190	7955.	0.000	14.788	.01322	2477.	998.	4999.	24.012	5907.
36	33	4.767	.917	8306.	1686.	3.659	8475.	11.474	6.109	.00633	2138.	1000.	5000.	.992	238.
64	33	9.605	2.624	8041.	-42.	3.260	8041.	-.299	12.970	.01186	2424.	1000.	5000.	15.423	3794.
64	33	9.605	2.624	7813.	-636.	3.098	7839.	-4.652	17.593	.01528	2551.	996.	5000.	15.423	3794.
68	33	11.457	3.162	8032.	0.	3.254	8032.	0.000	13.119	.01197	2428.	998.	4999.	23.785	5851.
36	34	5.079	.891	8412.	1566.	3.743	8557.	10.544	5.220	.00555	2082.	1000.	5000.	.822	196.
64	34	9.954	2.487	8085.	-168.	3.299	8087.	-1.187	12.054	.01115	2394.	1000.	5000.	13.734	3375.
64	34	9.954	2.487	7843.	-776.	3.131	7881.	-5.649	16.527	.01450	2525.	996.	5000.	13.734	3375.
69	34	12.383	3.162	8105.	0.	3.316	8105.	0.000	11.662	.01085	2381.	998.	4999.	23.498	5778.
36	35	5.409	.861	8514.	1444.	3.828	8636.	9.626	4.458	.00487	2028.	1000.	5000.	.672	158.
64	35	10.307	2.344	8124.	-290.	3.336	8129.	-2.042	11.248	.01053	2367.	1000.	5000.	12.183	2991.
64	35	10.307	2.344	7866.	-914.	3.161	7919.	-6.628	15.602	.01382	2501.	996.	5000.	12.183	2991.
70	35	13.376	3.162	8169.	0.	3.372	8169.	0.000	10.485	.00993	2339.	998.	4998.	23.214	5706.
36	36	5.757	.826	8612.	1320.	3.913	8712.	8.716	3.804	.00427	1975.	1000.	5000.	.539	124.
64	36	10.663	2.194	8157.	-410.	3.369	8168.	-2.874	10.557	.00999	2342.	1000.	5000.	9.945	2437.
64	36	10.663	2.194	7883.	-1049.	3.188	7952.	-7.533	14.815	.01323	2480.	995.	5000.	9.945	2437.
71	36	14.431	3.162	8224.	0.	3.421	8224.	0.000	9.555	.00919	2303.	998.	4998.	22.118	5433.
36	37	6.127	.784	8705.	1195.	3.999	8786.	7.815	3.243	.00373	1924.	1000.	5000.	.423	96.
64	37	11.022	2.038	8185.	-523.	3.399	8202.	-3.658	9.970	.00952	2320.	1000.	5000.	8.736	2139.
64	37	11.022	2.038	7893.	-1181.	3.211	7981.	-8.507	14.169	.01275	2462.	994.	5000.	8.736	2139.
72	37	15.538	3.162	8269.	0.	3.461	8269.	0.000	8.854	.00863	2274.	998.	4998.	21.937	5387.
36	38	6.519	.737	8794.	1068.	4.086	8859.	6.923	2.762	.00327	1873.	1000.	5000.	.323	71.
64	38	11.383	1.875	8207.	-628.	3.425	8231.	-4.379	9.490	.00914	2301.	1000.	5000.	7.630	1867.
64	38	11.383	1.875	7896.	-1306.	3.229	8003.	-9.389	13.674	.01238	2448.	994.	5000.	7.630	1867.
73	38	16.677	3.162	8301.	0.	3.491	8301.	0.000	8.366	.00823	2253.	998.	4998.	21.749	5339.
36	39	6.936	.681	8880.	939.	4.175	8929.	6.037	2.349	.00286	1823.	1000.	5000.	.236	50.
64	39	11.746	1.705	8227.	-749.	3.453	8261.	-5.199	9.004	.00875	2281.	1000.	5000.	6.566	1606.
64	39	11.746	1.705	7895.	-1448.	3.248	8026.	-10.393	13.179	.01200	2433.	993.	5000.	6.566	1606.
74	39	17.890	3.162	8330.	0.	3.518	8330.	0.000	7.949	.00788	2233.	998.	4998.	21.505	5276.

I	J	X	Y	U	V	M	VMAG	THETA	P	RHO	T	PT	TT	MDOT	F
36	43	7.381	.618	8961.	809.	4.264	8998.	5.158	1.996	.00249	1774.	1000.	5008.	.164	33.
64	43	12.112	1.529	8237.	-838.	3.870	8275.	-5.807	8.726	.00252	2269.	1000.	5283.	5.625	1376.
64	40	12.112	1.529	7882.	-1565.	3.255	8035.	-11.215	12.939	.01185	2427.	992.	5628.	5.625	1376.
75	40	18.456	2.994	8334.	-13.	3.522	8334.	-.089	7.836	.00784	2231.	998.	4999.	19.795	5657.
75	40	19.025	3.162	8337.	0.	3.525	8337.	0.000	7.844	.00780	2229.	998.	4998.	21.274	5217.

PROPERTIES ALONG THE NOZZLE WALL CONTOUR.

I	X	Y	P	F(1-D)	F(2-D)	ETA(F)	ISP(1-D)	ISP(2-D)	ETA(I)
11	0.00000	1.00000	444.242	3855.	3832.	.9940	170.176	190.942	1.0040
12	.00017	1.00000	424.910	3809.	3832.	1.0060	187.898	190.942	1.0162
13	.00035	1.00001	406.852	3809.	3832.	1.0060	187.899	190.943	1.0162
14	.00052	1.00001	389.830	3809.	3832.	1.0060	187.900	190.943	1.0162
15	.00070	1.00002	373.685	3809.	3832.	1.0060	187.902	190.945	1.0162
16	.00087	1.00004	358.305	3809.	3832.	1.0060	187.904	190.946	1.0162
17	.00105	1.00005	343.606	3809.	3832.	1.0060	187.907	190.948	1.0162
18	.00122	1.00007	329.525	3809.	3832.	1.0060	187.911	190.950	1.0162
19	.00139	1.00010	316.011	3809.	3832.	1.0060	187.914	190.952	1.0162
20	.00156	1.00012	303.024	3809.	3832.	1.0060	187.919	190.955	1.0162
21	.00174	1.00015	290.529	3810.	3832.	1.0060	187.923	190.957	1.0161
22	.00191	1.00018	278.499	3810.	3832.	1.0060	187.929	190.960	1.0161
23	.00208	1.00022	266.909	3810.	3832.	1.0060	187.934	190.963	1.0161
24	.00225	1.00026	255.739	3810.	3832.	1.0059	187.940	190.965	1.0161
25	.00242	1.00030	244.969	3810.	3833.	1.0059	187.947	190.968	1.0161
26	.00259	1.00034	234.583	3810.	3833.	1.0059	187.954	190.972	1.0161
27	.00276	1.00039	224.568	3810.	3833.	1.0059	187.962	190.975	1.0160
28	.00292	1.00044	214.908	3810.	3833.	1.0058	187.970	190.978	1.0160
29	.00309	1.00049	205.593	3811.	3833.	1.0058	187.978	190.981	1.0160
30	.00326	1.00054	196.610	3811.	3833.	1.0058	187.987	190.984	1.0159
31	.00342	1.00060	187.949	3811.	3833.	1.0057	187.997	190.988	1.0159
32	.00358	1.00066	179.599	3811.	3833.	1.0057	188.007	190.991	1.0159
33	.00375	1.00073	171.552	3811.	3833.	1.0057	188.017	190.994	1.0158
34	.00391	1.00079	163.799	3812.	3833.	1.0056	188.028	190.997	1.0156
35	.00407	1.00086	156.330	3812.	3833.	1.0056	188.039	191.000	1.0157
36	.00423	1.00094	149.137	3812.	3833.	1.0055	188.051	191.004	1.0157
37	.17140	1.07820	147.453	4002.	3901.	.9747	197.404	194.362	.9846
38	.32802	1.14935	143.523	4132.	3966.	.9598	203.825	197.605	.9695
39	.47445	1.21477	138.149	4231.	4027.	.9518	208.713	200.658	.9614
40	.61404	1.27615	131.917	4311.	4085.	.9475	212.662	203.536	.9571
41	.74882	1.33451	125.268	4378.	4139.	.9455	215.966	206.251	.9550
42	.87997	1.39044	118.521	4435.	4191.	.9448	218.795	208.807	.9543
43	1.00805	1.44425	111.899	4485.	4239.	.9451	221.259	211.205	.9546
44	1.13330	1.49608	105.548	4529.	4284.	.9459	223.402	213.447	.9554
45	1.25578	1.54603	99.555	4567.	4326.	.9471	225.301	215.535	.9567
46	1.37564	1.59419	93.958	4601.	4365.	.9485	226.987	217.477	.9581
47	1.49164	1.64012	88.833	4632.	4400.	.9501	228.475	219.260	.9597
48	1.60753	1.68535	83.999	4659.	4434.	.9517	229.835	220.948	.9613
49	1.72279	1.72969	79.490	4684.	4466.	.9534	231.076	222.536	.9630
50	1.83914	1.77377	75.238	4708.	4496.	.9551	232.227	224.051	.9648
51	1.95941	1.81865	71.148	4730.	4526.	.9569	233.318	225.526	.9666
52	2.08922	1.86628	67.067	4752.	4556.	.9589	234.394	227.021	.9685
53	2.23957	1.92041	62.742	4774.	4588.	.9610	235.522	228.631	.9707
54	2.43095	1.98772	57.808	4800.	4626.	.9637	236.795	230.506	.9734
55	2.69973	2.07919	51.823	4831.	4673.	.9672	238.315	232.838	.9770
56	3.11422	2.21330	44.339	4868.	4733.	.9722	240.157	235.836	.9820
57	3.77327	2.40913	35.701	4909.	4805.	.9788	242.140	239.398	.9887
58	4.40015	2.57557	30.158	4931.	4852.	.9838	243.267	241.755	.9938
59	5.03109	2.72358	26.248	4944.	4885.	.9880	243.896	243.406	.9980
60	5.67192	2.85387	23.434	4950.	4908.	.9915	244.192	244.557	1.0015
61	6.32871	2.96644	21.388	4952.	4924.	.9944	244.269	245.346	1.0044
62	7.00686	3.06041	19.984	4951.	4934.	.9967	244.215	245.876	1.0068
63	7.70052	3.13313	18.987	4948.	4941.	.9986	244.103	246.213	1.0086
64	8.07105	3.16228	18.649	4947.	4944.	.9993	244.042	246.331	1.0094

I	X	Y	P	F(1-D)	F(2-D)	EVAC(F)	ISP(1-D)	ISP(2-D)	EVAC(T)
64	8.07105	3.16228	24.301	4947.	4934.	.9993	246.842	246.331	1.0093
65	9.06460	3.16228	19.518	4947.	4944.	.9993	246.842	246.331	1.0094
66	9.80266	3.16228	16.534	4947.	4944.	.9993	246.842	246.331	1.0094
67	10.60014	3.16228	14.188	4947.	4944.	.9993	246.842	246.331	1.0094
68	11.45727	3.16228	13.119	4947.	4944.	.9993	246.842	246.331	1.0093
69	12.38295	3.16228	11.662	4947.	4944.	.9993	246.842	246.331	1.0090
70	13.37567	3.16228	10.485	4947.	4944.	.9993	246.842	246.331	1.0094
71	14.43128	3.16228	9.555	4947.	4944.	.9993	246.842	246.332	1.0094
72	15.53847	3.16228	8.850	4947.	4944.	.9993	246.842	246.332	1.0090
73	16.67735	3.16228	8.366	4947.	4944.	.9993	246.842	246.332	1.0090
74	17.89025	3.16228	7.948	4947.	4944.	.9993	246.842	246.331	1.0690
75	19.02550	3.16228	7.844	4947.	4944.	.9993	246.842	246.331	1.0094

PERFORMANCE OF THE SCARFED EXTENSION

I	X	Y	P	PSI	DFX	ISPX	DFY	ISPY	ISP
64	8.071	3.162	24.301	0.000	0.	246.331	0.	0.000	246.331
65	9.065	3.162	19.510	35.055	0.	246.331	-.1364E+02	.680	246.331
66	9.803	3.162	16.934	46.055	0.	246.331	-.1079E+02	1.217	246.331
67	10.600	3.162	14.788	57.435	0.	246.331	-.4640E+01	1.449	246.331
68	11.457	3.162	13.119	67.557	0.	246.331	.3570E+01	1.271	246.331
69	12.383	3.162	11.662	77.716	0.	246.331	.1288E+02	.629	246.331
70	13.376	3.162	10.485	88.194	0.	246.331	.2257E+02	.496	246.331
71	14.431	3.162	9.555	99.277	0.	246.331	.3115E+02	2.048	246.331
72	15.533	3.162	8.854	111.307	0.	246.331	.3709E+02	3.897	246.331
73	16.677	3.162	8.366	124.840	0.	246.331	.3868E+02	5.824	246.331
74	17.890	3.162	7.948	142.442	0.	246.331	.3630E+02	7.633	246.331
75	19.025	3.162	7.844	180.000	0.	246.331	.1572E+02	8.416	246.331

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SUMMARY OF OVERALL SCARFED NOZZLE PERFORMANCE PARAMETERS

   MDOT   =     .200691E+02 LBM/SEC
   FXN    =    -.494364E+04 LBF      ISPXN    =  246.331 (LBF-SEC)/LBM
   FYN    =     .168897E+03 LBF      ISPYN    =    8.416 (LBF-SEC)/LBM
SUMMARY OF OVERALL MISSILE PERFORMANCE PARAMETERS

   FXM    =    -.436577E+04 LBF      ISPXM    =  217.537 (LBF-SEC)/LBM
   FYM    =    -.232555E+04 LBF      ISPYM    =  115.877 (LBF-SEC)/LBM
   ETA    =     .8831                BETAEFF  =   27.980 DEG
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